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AUTOMOTIVE and Aviation INDUSTRIES

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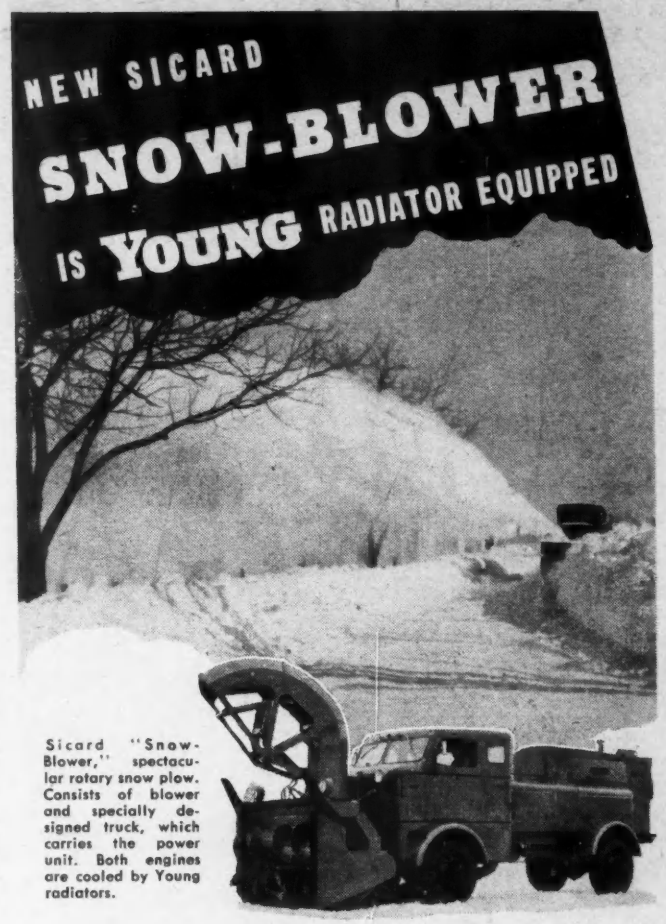

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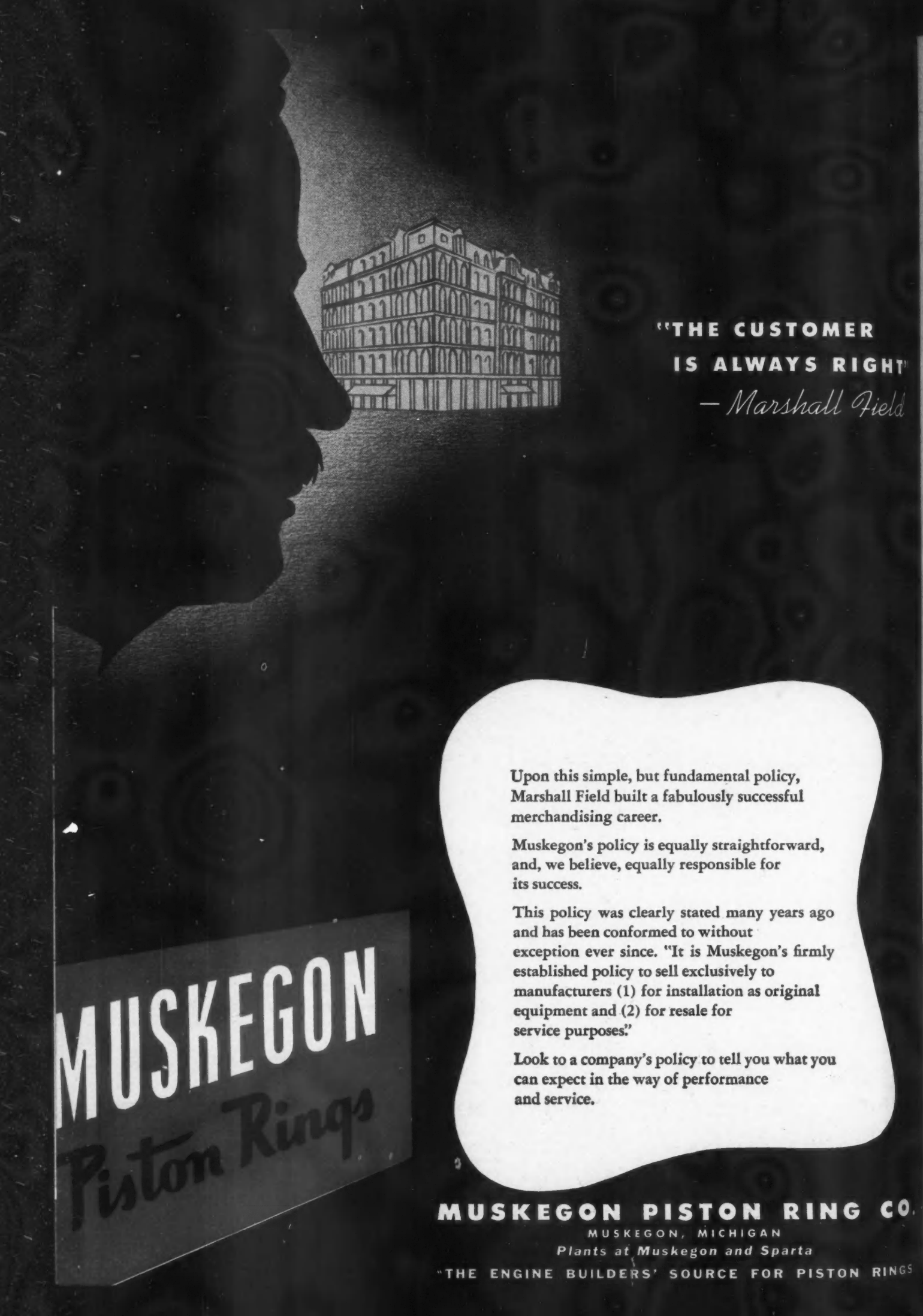

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AUTOMOTIVE and AVIATION INDUSTRIES

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Volume 96, No. 2

The Spirit of Enterprise

By William K. Jackson

Pres., Chamber of Commerce of the United States

THE American enterpriser is the hope of an undernourished world. He is the fellow who gets up early and works late, looking for a chance to move ahead in the world. He is the fellow who makes the wheels go around. He is the personification of the urge to accomplish.

In striving for his objectives, the man of enterprise is making the world a better place to live in. He reaps his reward in the measure that he serves the wants and aspirations of his fellow men.

He is the fellow who will have to supply all those tremendous accumulated needs which have come out of the war. These needs can be supplied only through the drive, the initiative, the knowhow of private enterprise.

The people are tired of shortages. They want production, uninterrupted production. They have had enough of monopoly union power which enables one man or a few labor leaders, to paralyze the greatest industrial nation on earth and destroy production when the country needs it most.

The spirit of enterprise is not the spirit of monopoly, whether it be monopoly of political power, of labor or of production. Enterprise thrives on competition. Enterprise thrives on freedom. Enterprise serves the people best, gives forth its matchless capacity to produce and raise living standards, when it has wide leeway to carry out the judgments of individual initiative and knowhow, without the meddling of the state.

Nature's method of progress is the slow but sure method of trial and error, pursued in the venturesome spirit of enterprise, tested in the light of practical results. Businessmen know this method by hard experience.

That is why businessmen now ask for the green lights to carry out the productive tasks of peace in the time-tested methods of the free market, where the maximum freedom can be found to adjust supply to demand through the medium of price and to satisfy the demands of the consumer.

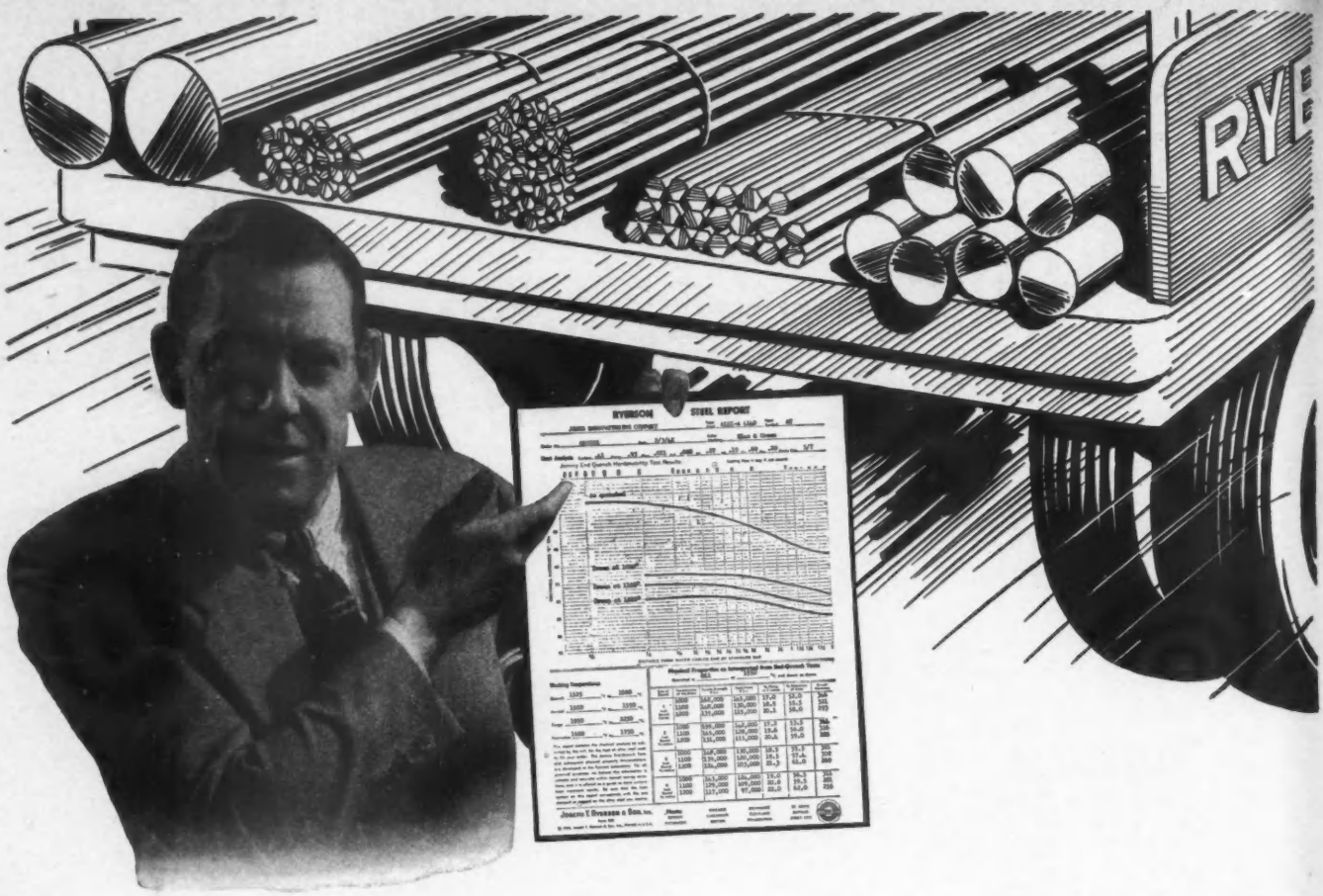
The king of the market place is the consumer. He, and she, rule supply and demand. To the consumer, the businessman bows. Now the civilian consumer is back on the throne.

With a little encouragement, and a period of uninterrupted production, free industry will supply the wants of the consumer faster and more satisfactorily than any state-controlled system. Some of the basic requirements for the greatest productive period in the history of this or any other country are:

First, we must learn the way to industrial peace. The coal strike has shown this more clearly than any of the long procession of strikes in essential industries which have plagued this country. Industrial peace will require some realistic revision of the National Labor Relations Act, and other federal labor laws, to bring about equality between labor and management around the collective bargaining table.

Second, the federal budget must be balanced and taxes reduced and revised. This will remove the primary source of inflation. The chief source of our bloated

(*Turn to page* 88, *please*)



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Looking Ahead into 1947

Optimism Prevails In Spite of Wage, Strike and Portal-to-Portal Threats.

By Leonard Westrate

ALTHOUGH 1946 undoubtedly was a banner year of troubles for the automotive industry, this year is starting off on a note that indicates many of the previous year's ills still are very much in evidence. The principal obstacles standing in the way of profitable operation are the carryover of materials shortages, principally sheet and strip steel, low labor productivity, and future and back pay demands by organized labor running into boxcar figures.

On the wage increase battle front, it is the same old barrage of hit-and-run statistics that prevailed last year. Like the Bourbons of France, the union masterminds have "neither remembered anything nor forgotten anything." The opening gun was the Nathan report which contended that industry in general could pay a 25 per cent wage increase with no boost in prices. Robert Nathan, author of the report, was the economist who predicted in late 1945 that there would be eight million unemployed by last spring. George Romney, general manager of AMA, quickly took up the challenge by stating that despite profit forecasts made a year ago by Nathan and by the since repudiated Wallace report, the automobile industry suffered a net loss of $5.5 million in the first nine months of 1946 after tax refunds. Experience during the last year, he said, shows that further wage increases will result in higher costs and higher prices, leading to fewer customers and unemployment. C. E. Wilson, president of General Motors, also has said that an increase of 25 per cent in wages will mean a corresponding boost in prices of the same amount.

Forgetting how the union had played fast and loose with a forecast of G.M.'s profits last year, George Addes, secretary-treasurer of the UAW-CIO has come forth with a prediction on the automotive industry's profit position for 1947. It makes two principal points: namely, that at present prices, costs, and wages, the industry will make profits before taxes, of about $1.957 billion when it reaches its planned 1941 volume, even with productive efficiency no higher than in 1941, and that even after paying a 25 per cent increase in wages, the industry still would show a profit of $1.350 billion before taxes and $835 million after taxes, which would be three times the annual profit for the years 1936-39. The report has the same flavor of plausibility that characterized the voluminous studies presented by the union last year in the General Motors negotiations and in essence has the same weakness—it attempts to justify large wage increases now on the basis of estimated future profits.

Despite all the "put-'em-on-the-spot" statistics pouring out of union headquarters, the general belief is that any wage increases will be based on the higher cost of living and most certainly will carry no committment about holding down prices of automobiles. Observers close to union leaders say that there is a very good possibility that the wage question in the automotive industry may be settled for a boost of 15 cents an hour or less without a strike. Although the UAW-CIO is levying a $1 assessment against members for a strike fund, it is thought that this is good strategy, but does not necessarily indicate definite intention to strike. If the slow pace of the Chrysler negotiations is any criterion, the UAW-CIO is maintaining a cautious demeanor with no inclination to force the issue. The Chrysler wage talks have been going on for more than 60 days now with frequent intermissions, and the general opinion is that the union would like to let the steel union be bell-wether on wage increases this time. In general, no strikes of any consequence are looked for in the next month or two in the automotive industry, and there is strong hope that they may be avoided altogether.

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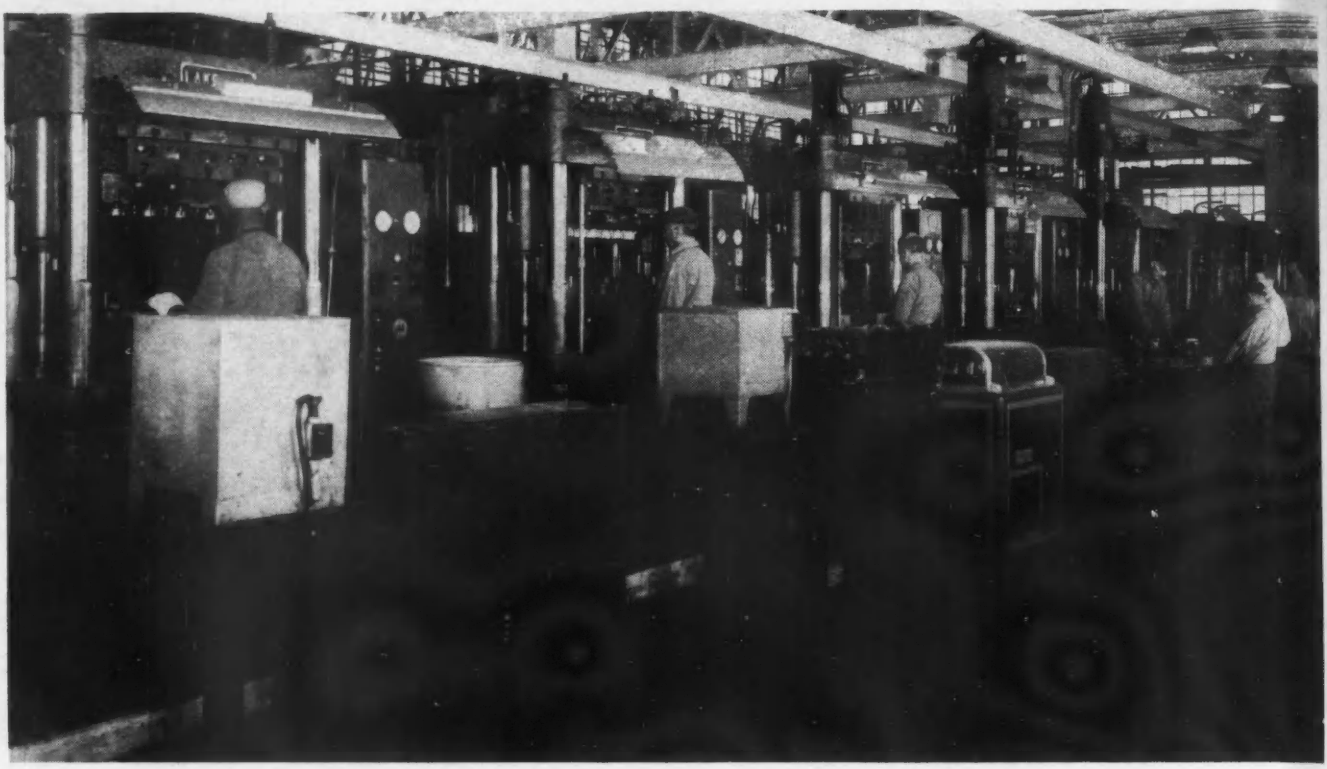
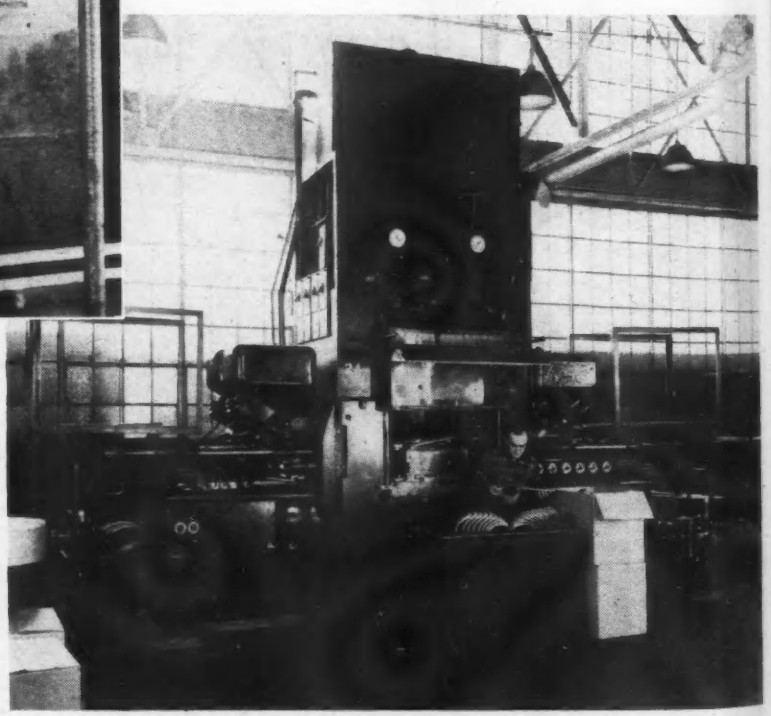


A perspective of the large battery of high-capacity Lake Erie presses in the compression molding department. One of the high-frequency heating cabinets may be seen in the center.

High Speed Plunger Molding

Developments

Metal screens are attached to the plastic radio grille in a special setup. The hot points in the die soften the plastic and cause it to flow over the grills at these points while the grille is pressed in place between the dies.



This enormous machine is an H-P-M hydraulic plastic injection unit of 32-oz. capacity. Fitted with four horizontal cylinders, this machine produces four instrument panel sections at a time.

CONSIDERING the specialization involved in the development and production of molded plastics, it is of interest to find that Ford Motor Co. is operating what is thought to be perhaps the largest tonnage capacity plastics molding plant in the midwest. Housed in a portion of what was originally the Ford tire plant at the Rouge, the Plastics Department produces almost 80 per cent of Ford plastic parts—excluding steering wheels but including service parts for old models. Moreover, it makes 100 per cent of the parts tooled here. Current production comprises some 360 part numbers made for Ford, Mercury, and Lincoln cars, and including service parts.

These operations feature large molding presses rather than small units, among which are some of the largest machines known to the art. Doubtless the biggest unit of its kind is the new Watson-Stillman injection molding press of 80-oz capacity which is currently tooled with a four-cavity mold for producing radio grilles. Unusual feature of this machine is the external pre-heating chamber and injection cylinder, the latter feeding directly into the single main cylinder of the machine.

From the standpoint of operating economy the plastics plant is arranged with two compact and independent divisions — one for injection molding, the other for compression molding. Each is comparatively self-contained.

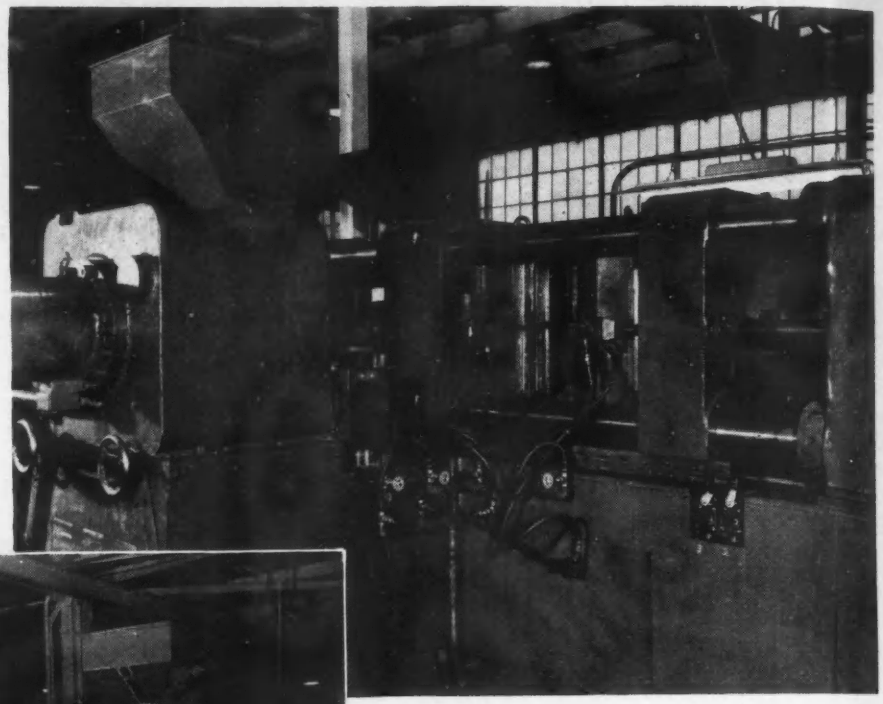
The injection molding department specializes in formulations of thermoplastics of cellulose-acetate butyrate (Tenite II) types in a variety of striking colors. Some of the parts produced from these materials are as follows: Radio grilles, instrument panels, instrument panel bezels, choke and throttle knobs, cigar lighter knobs, horn buttons, window regulator knobs, escutcheons, and gearshift lever knobs (in two sections, cemented together). In addition, flexible parts such as insulators and ignition harness sleeves are molded from Vinylite (vinyl-chloride copolymer) plastic, a flexible rubber-like material.

The compression molding department, specializing in the production of parts for ignition circuits, uses the well known phenol-formaldehyde thermosetting formulations—Bakelite, Durez, Durite and Makalot. Among the parts made here are: Distributor housings, terminal plates, distributor rotors, switch bases, and

and Preheating of Preforms Among New

at Ford's Plastics Plant

Another of the advanced types of injection molding machines found at Ford is this new 16-oz. Reed-Prentice machine. It is tooled to produce two instrument panels at a time.



Said to be the largest plastic injection molding machine known to the art, is shown below. This 80-oz. capacity Watson-Stillman unit dominates the scene in the Ford plastic department and is tooled to produce four radio grilles at a time.

At the right is a rear view of the 80-oz. capacity Watson-Stillman machine showing detail of the large pre-heating or plasticizing chamber which makes this unusual capacity possible.

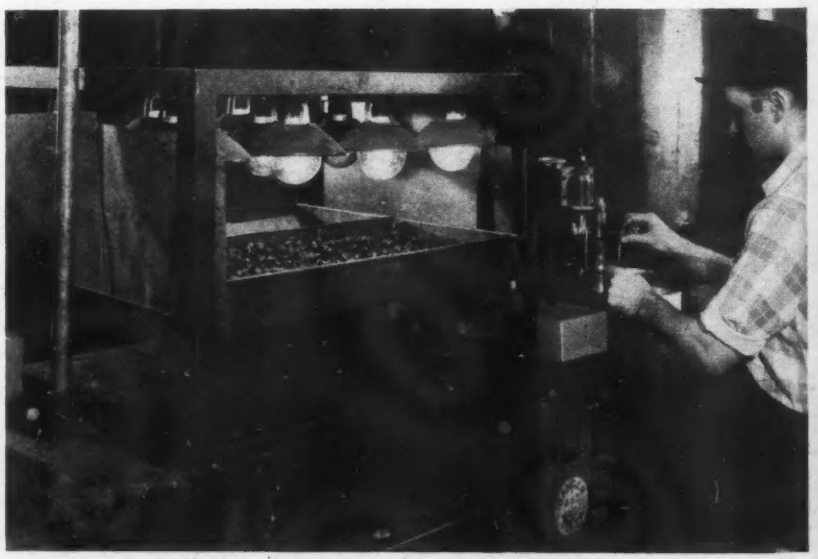
coil housings for buses. As a matter of standardized practice all molds are highly polished and chromium plated to reproduce polished surfaces on finished parts. After a period of service, when the surface of the mold becomes marred or scratched, molds are refinished by stripping the chromium, repolishing, then chromium plating once more. All molds in the entire setup are electrically heated, being held to 300-350 F.

Injection Molding Department

Equipment in this department ranges in capacity from four oz for the conventional Reed-Prentice machines to 80 oz for the Watson-Stillman unit. They have a large battery of Reed-Prentice machines, including a large 16-oz unit with a single cylinder. Another of the outstanding machines is a large H-P-M unit of 32 oz capacity having four horizontal plungers, each of 8-oz capacity. It is set up at the moment for producing instrument panel sections, made in a four-cavity mold.

The Watson-Stillman Machine, as mentioned earlier, is producing radio grilles, four at a time. Its operation is completely automatic.

Thermoplastic materials are handled in granular form, as supplied by the producers, and are thoroughly



Typical of the small assembly presses is this view of equipment for pressing-in inserts. The plastic knobs which take the inserts are held under the bank of infra-red lamps at the left to soften the material prior to pressing the insert.

One of the several Hammond Machinery Builders automatic polishing machines is shown here. Work is mounted on the spindles of the indexing fixture.

dehydrated before use by putting them through infra-red heating ovens. All rejects, trim, etc., are salvaged 100 per cent in the interest of economy and reprocessed as material for moldings of dark colors. Such scrap is delivered to a large Banbury mixer where it is blended and colored. Following initial mixing, the material is drawn out in fairly large lumps, cooled, and then reprocessed in the mill to break up the large chunks and grind to granular form suitable for the molding machines.

Owing to the enormous volume and large variety of parts, each of the machines is scheduled to handle a large number of different molds. To facilitate economical runs, parts are put through in sufficient quantity to provide a 30 day bank before the setup is torn down. These banks are stored in a stock room against assembly department requisitions.

A well equipped finishing room is found adjacent to the molding department. Here the parts are burred, ground, and hand polished to produce good quality; and in some cases striped or painted, or cemented as in the case of the two-piece gearshift lever knob.

Although hand operations predominate, by the very nature of the work, automatic machine methods of unusual interest have been employed wherever feasible. One example is found in a battery of Hammond universal automatic polishing machines. These are of eight-spindle design and are used for buffing a variety of knobs. Here, too, is a unique Colonial Broach machine for the assembly of the metal screen to the plastic radio grille. Formerly the screens were stapled to the grille. Now the screen is installed in the grille, inserted in the heated die of the machine and pressed in place. The heated die softens the plastic at the

(*Turn to page* 82, *please*)

This is the distributor cap coating setup mentioned in the text. Spraying is done at the right within the conveyor loop, drying is done in the infra-red lamp cabinet at the left. The method of holding and masking caps in the fixture is shown here.

Strength T
Douglas D

By Milton A. Miner

THE biggest job that a test engineer is called upon to do starts on the day that a complete airplane, costing nearly a million dollars in the case of the DC-6, is delivered to his care for strength testing. In 10 to 12 days, a complete and comprehensive series of proof tests covering both CAA, company, and customer requirements must be completed to demonstrate that the strength of the entire structure is adequate yet the weight not excessive.

Some of the special equipment and techniques employed in the static testing of the DC6 are illustrated by the accompanying photographs. Ultra-sensitive load dynamometers were designed and built by Douglas engineers to give instantaneous information to the engineer at the central controls. The engineer in charge of the test had a control booth from which the entire test loading and data recording were directed.

Hydraulic pumps and proportioning valves were specially designed to give uniform application and release of load to the structure through a single hydraulic system, thus avoiding the dangers inherent in a multiple system. Air valves and sensitive manometers controlled the air pressure for cabin pres-

At the top of this page the aft fuselage is shown being subjected to maximum load applied to the tail stub by the hydraulic cylinder in the foreground. Each lead pig on the platform weighs 50 lb while the platform weighs about 1000 lb. Wrinkles in the fuselage skin disappear when the load is removed

At the left is an airtight plastic panel fitted with electrical terminals which is substituted for one of the windows. This provides an airtight means of connecting the strain gages inside the fuselage with electronic recording instruments on the outside while the interior is pressurized with compressed air

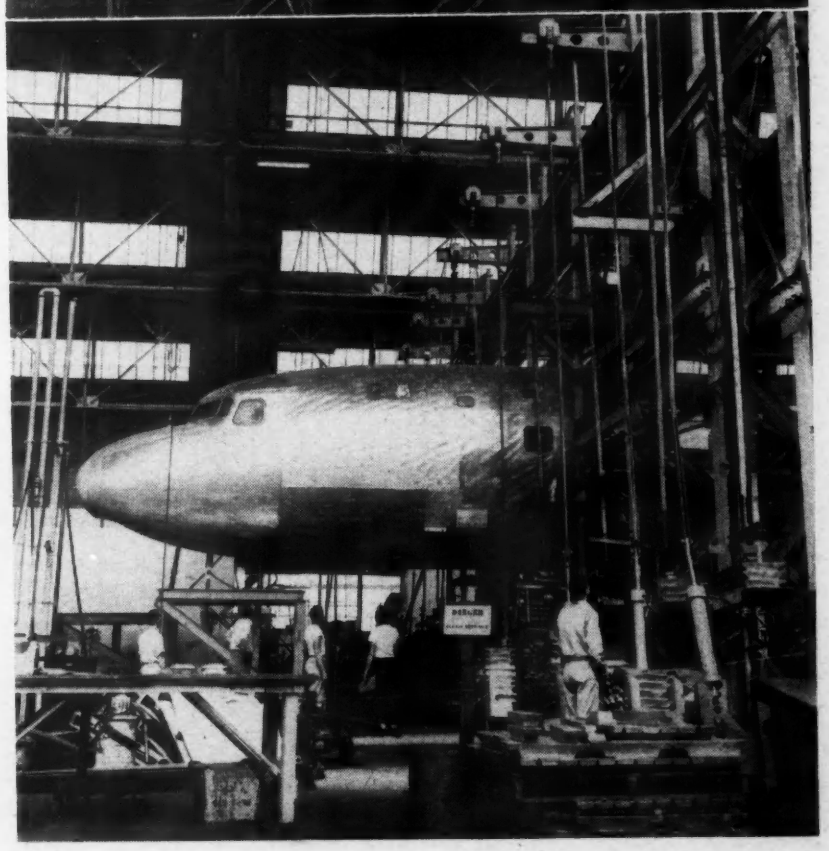
Testing DC-6

Formerly Strength Test Engineer,
Douglas Aircraft Co., Inc.

surization. A precision rate-of-climb meter indicated the rate at which air was admitted to the cabin, and water valves and draft gages controlled the dead weight loading of the fuselage water tanks.

All strain measurements were recorded by automatic equipment, as were the small deflections where precision is required A deflection ring of Douglas design incorporating electrical resistance strain gages provided a remote recording deflection instrument. Since the wing tip of the DC-6 deflects nearly 40 in. at limit load, scales capable of measuring these large deflections were hung from the wing at various points. Readings were taken then with surveyor levels. The engineer in charge had a microphone at hand so that he could announce the precise moment that final adjustments were made preliminary to starting the recording of data.

With the use of such specially designed equipment, a complete airplane of nearly 100,000 lb gross weight was completely tested in a fraction of the time and cost of previous methods. At the same time, load distribution was improved, chances of error were greatly reduced and danger to personnel was maintained at a minimum.



Shown at the top of this page is the wing loading method used throughout the tests. A steel scaffolding supports pivots for walking beams (top of the picture), which are pulled downward on their far ends by hydraulic cylinders and lead ballast. The resulting upward pull on the near end of the beams is transferred to the wing surface by steel straps and a whiffle-tree linkage. Both flaps and aileron are free to move while the wing is bent

In this photo, at the right, showing the forward side of the steel scaffolding and walking beams, the cockpit area of the fuselage is under load. The hydraulic cylinders and lead ballast in the foreground are used to pull the walking beams downward in wing loading

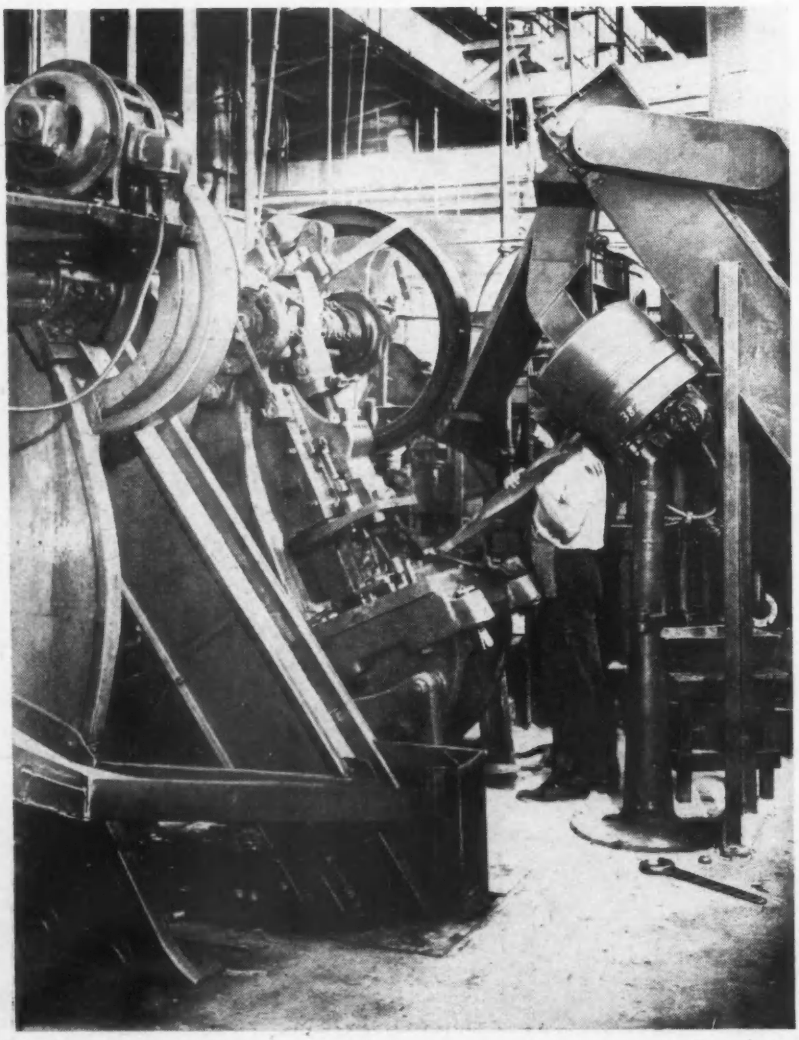
Handling Mechanization **Boosts** *Shock Absorber*

IN anticipation of a phenomenal growth in business, the management of The Monroe Auto Equipment Co., Monroe, Mich., embarked upon an ambitious program of plant expansion, modernization, and mechanization which was begun directly after V-J Day and is in operation at this writing. Scope of product coverage has been greatly expanded, now includes direct acting shock absorbers for passenger cars and trucks, for railroad equipment, and for motorcycles. Plant 4—a new building a few blocks from Plant 1—houses the manufacture of sway bars for most popular makes of motor cars, independently suspended tractor seats and truck seats, and a line of materials handling equipment.

To give some idea of the present volume of business consider that prewar production of shock absorbers was at the rate of 5000 per day whereas the goal for the near future is 25,000 per day, ultimately is expected to go up to 40,000 per day. Similarly, while they produced only about 4000 sway bars per day prewar, present output is around 17,000 per day.

In appraising the current operation it is important to note that the company has taken advantage of modern equipment and advanced manufacturing techniques combined with maximum automaticity of individual operations through a coordinated system of materials handling. Skillful blending of these elements has reduced the manual handling of work to the minimum and has effected a marked increase in productivity per worker. Monroe employs more than 1700 workers as compared with a prewar peak of but 500.

Initial analysis of the steps involved in the production of small parts and the multiplicity of sub-assembly and assembly stages showed clearly that much of the time expended by the workers was consumed in many handlings of raw materials, of numerous handlings at the machine stations, and additional handling of parts and subassemblies in the assembly department. The solution was found in a scheme of mechanizing all steps in the process. Essentially, the philosophy



Single operator takes care of battery of inclinable presses making caps and rings. Automaticity is achieved through the use of ingenious materials handling devices. For example, the machines are linked by a system of elevators which take work from one machine and deliver it to the hopper feeding the next operation. Note, in particular, the helically twisted chute in the center whose function is to turn the work right side up for the final forming operation

By Joseph Geschelin

Monroe *and Sway Bar* Output

Current Operation with Modern Equipment and Advanced Manufacturing Techniques Presents Striking Contrast with Prewar Setup

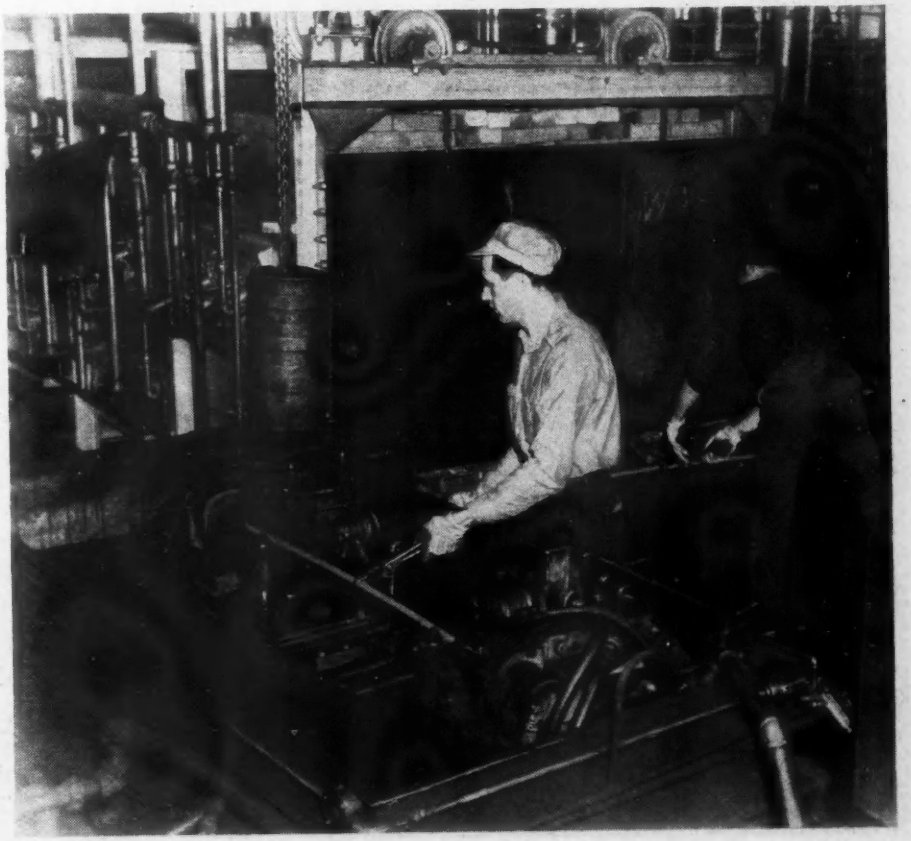
is to bring the work directly to the machine by mechanical means, to load machines automatically wherever possible by the use of magazine feed, to eject work automatically, and transport it by conveyor to the next operation. Once a part has been completed in the machine cycle, it is transported by conveyor through a washing stage, if necessary, and continues on the conveyor until it is removed for assembly.

Plant 1 is completely traversed by a system of monorail conveyors about a mile in length. The materials handling system also includes special conveyor lines in the tubing department, hopper and dial feeds and magazine feeds for individual machines, and portable flight elevators for loading finished parts from the machine into "tubs" or containers. Since the company began the marketing of a line of standardized "tubs" and skids, this equipment has been widely used for transporting parts from one operation to another. An unusual device is the "self-unloading tub" in which the base or floor can be lowered at one end to present an inclined plane for unloading work. By this means the container can be brought to the job, the floor dropped and the work removed as required with ease at one level.

Coming now to a sampling of activity in this plant, the reader is invited to compare the current setup with the description of the prewar plant which appeared in AUTOMOTIVE INDUSTRIES, July 15, 1941. The contrast is quite striking.

Shock Absorber Operations

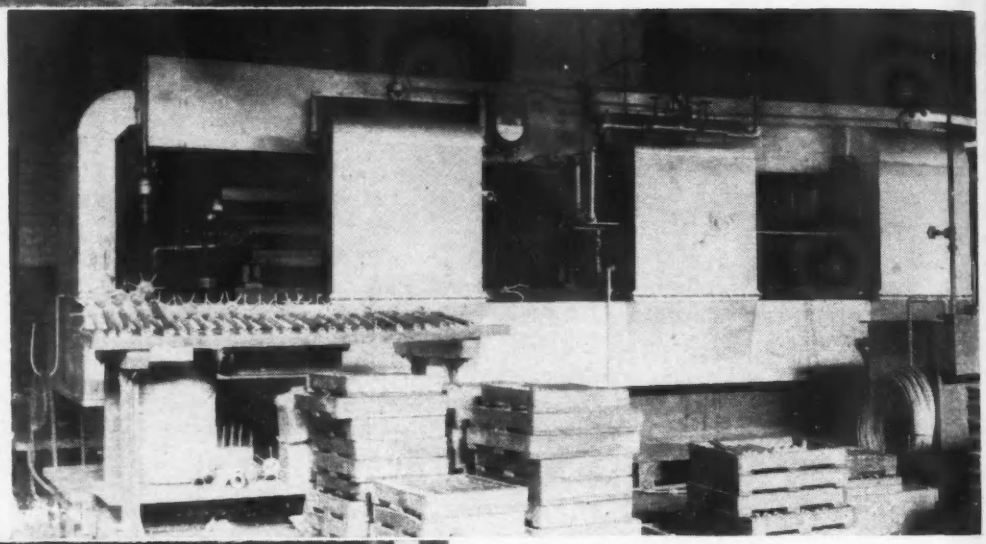
Initial operations begin with the tubing mills for producing the pressure tube, reserve tube, and dust tube. For this purpose they have three parallel lines of equipment, each one starting with the familiar Yoder mills featuring an electric seam welding head for welding the tubing. Operation of all tubing mills is completely automatic, starting with a feed roll containing alloy steel strip of the proper gage and width. The tube is formed in the first set of rolls, seam



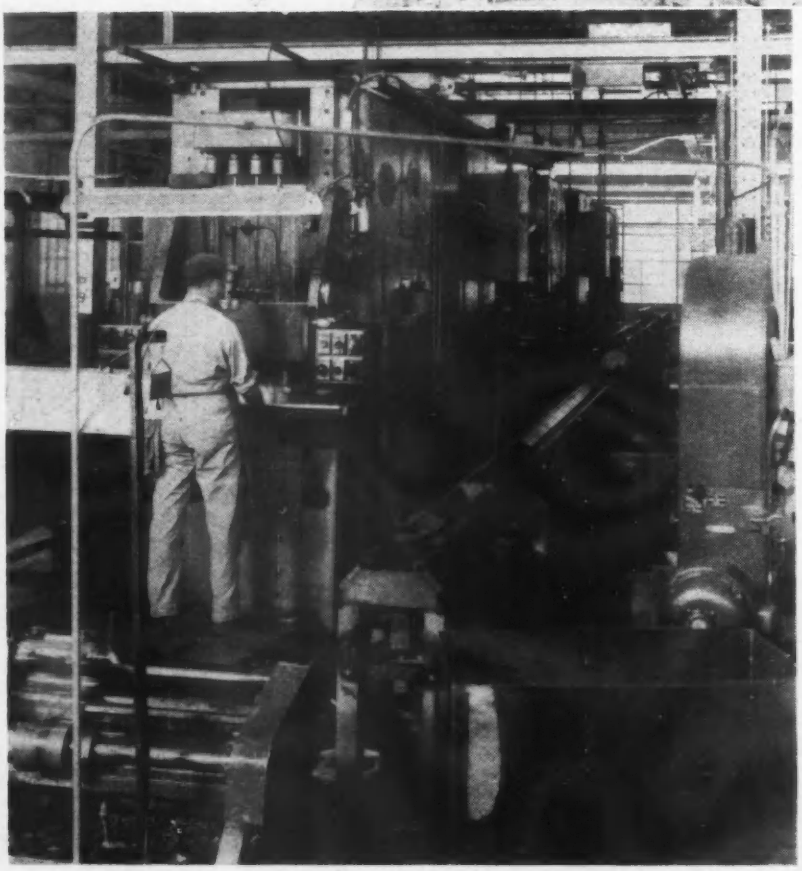
Looking down into one of the special hydraulically operated automatic bending machines for forming sway bars. One of the Surface Combustion furnaces may be seen in the center

In the foreground is one of the fully automatic Cincinnati centerless grinder and lapping lines for finishing piston rods. Work travels from the left to the end of the line in the background at which point the rods are fed into the enormous F. B. Stevens automatic chromium plating machine

Below is a view of the Stevens automatic chromium plating unit



Below is a battery of four, four station, American Broach hole broaching machines for sizing the bore of pressure tubes to a total tolerance of 0.001 in.



welded, then goes through a water spray cooling station some 20 ft in length. As tubing leaves the welding head, the flash is removed continuously by a single-point lathe tool tipped with Carboloy. Upen leaving the annealing station the tubing is drawn to exact size and is automatically cut off in standard 30-ft lengths.

Each of the two new tubing mills is served by a battery of two four-spindle bar-type Conomatics. They are tooled to cut the tubing to length and burr and counterbore one end. As the work is ejected from the machine it drops onto a conveyor which transports it to succeeding operations.

In the case of the reserve tubing the conveyor moves the work to a large W. F. & John Barnes machine fitted with a Kreuger head and an indexing fixture holding 16 pieces. This operation burrs the opposite end of the tube and threads it on the inside. The

tubes are then placed on the monorail and transported to a group of three small Hall Planetary machines in which they are squared perfectly at both ends. A feature of these machines is the use of magazine feed, permitting a single operator to handle the entire battery.

The pressure tube continues on a separate conveyor to a group of two double-end machines, designed by Monroe, for squaring both ends to size. It is then transported to a battery of four large vertical American Broaching machines. Each of these has a four-station fixture and four broaches for sizing the bore of the tube for its entire length. Total tolerance on the bore is held to 0.001 in. with excellent surface finish.

Fabrication of dust tubing is an outstanding example of the principle of mechanization developed here. We find a group of small machines arranged close together and linked by the conveyor. In the first operation, the long tubing is fed into a special machine which shears it to length, leaving the formation almost perfect. The tubes are ejected directly onto the conveyor and move to the next station where they enter a special double-end machine for burring and squaring both ends. This is essentially a spinning operation. From this point the tubing goes to one of a number of small machines for stamping one end and nicking the other. Then they move on the conveyor and are not handled until they are taken off at the final assembly line.

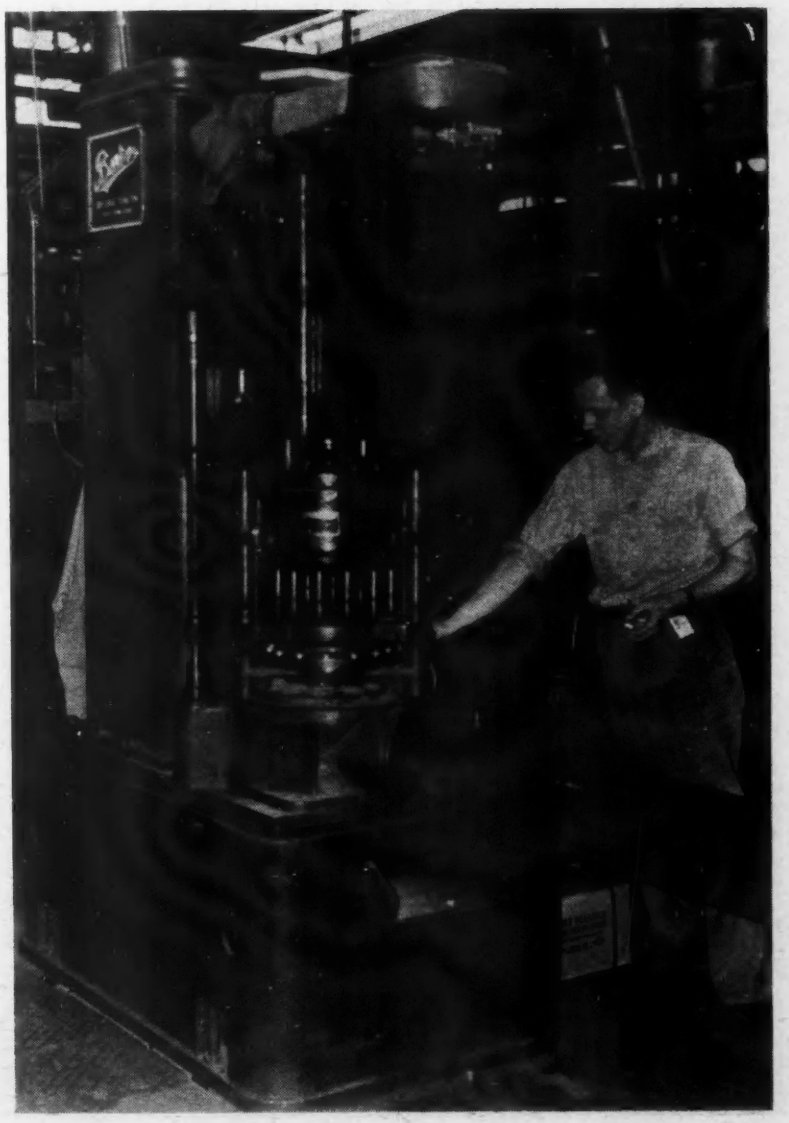
The next major department is the machine shop for making a variety of small components, including piston rods. The pistons, made of Durex powdered metal, first are ground on the OD in a Cincinnati Centerless grinder, then go to a battery of five New Britain-Gridley automatics for machining. Later the 12 oil holes are drilled in a special Buhr drill press having 12 spindles and provided with an indexing head holding 14 pieces at a time. This machine produces at the rate of 700 pieces per hour.

The screw machine department contains a battery of 32 New Britain-Gridley machines and 10 other units of various type. One group is set up for the production of the lower valve in two operations. The second operation machines are fitted with a motorized dial feed to reduce manual handling of the work. Another group of six-spindle New Britains is tooled for making piston rods.

A small closely knit and highly mechanized press line has been developed for making caps and rings which are welded later to the reserve tube end. The aim is to process each part from one operation to another without manual handling. In making the cap, the several presses are linked by conveyor sections which feed into portable elevators, these in turn feeding directly into a magazine chute. On the final forming operation the chute is twisted in a helix form so as to turn the work right side up in the die. The ring is bent to form on another press, the layout of equipment being so designed that the two parts—the cap and ring—meet at a Taylor-Winfield resistance welder and are joined as an assembly which is transported directly to the assembly line.

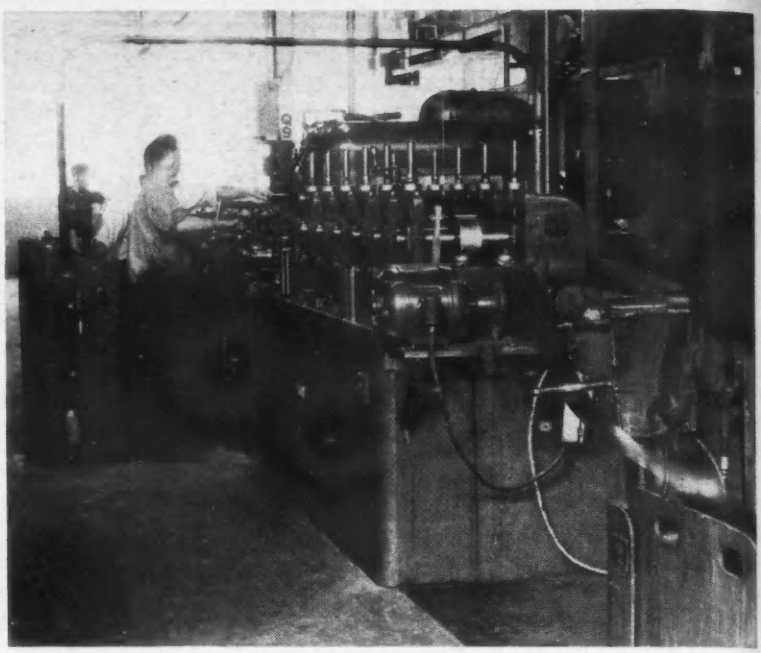
We now approach the initial stages of sub-assembly of the piston valve. In reality this is the heart of the shock absorber since there is no external adjustment of the unit. Each valve assembly is calibrated in accordance with a pressure diagram prepared by the engineering department. The valve disks are pressed in place on a small press, diaphragm action being checked against the indicator mounted directly on the machine. The assembly then is inspected at the next station by checking its action on a Denison Multipress.

In this department, too, we find three independent



Special Buhr drill press fitted with multiplex spindle drill head is used for drilling the multiplicity of holes in the piston in one setting

Engineering Library



Here is one of the two new Yoder tubing mills installed at Monroe. These take special strip steel from the mechanical feed at the right and roll into tubing of required size. The tubing is electrically welded at the center section, the flash removed by means of a single-point Carboloy tool while still hot, then quenched in the last station

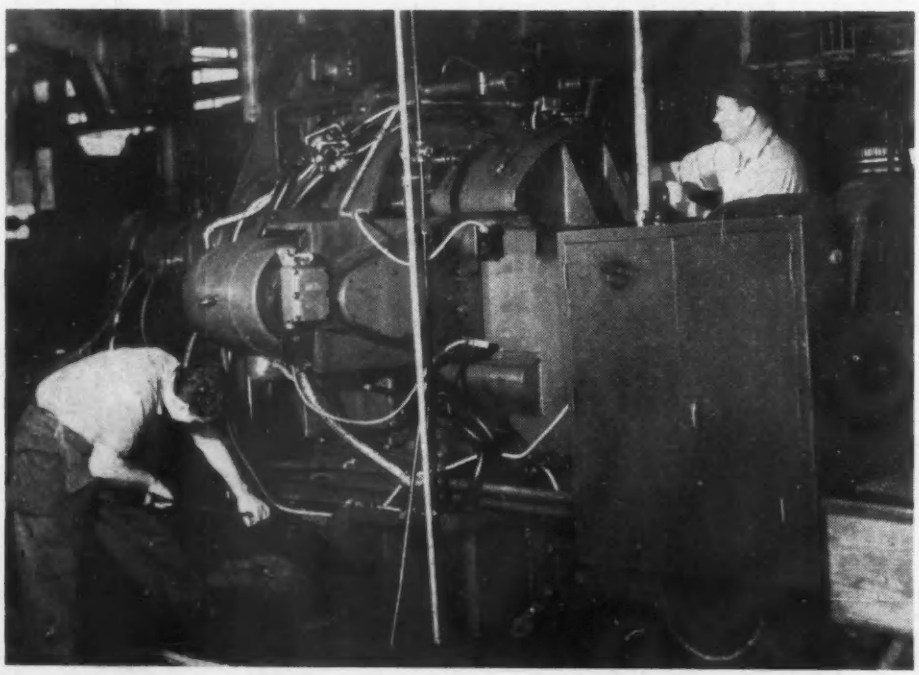
lines of Cincinnati Centerless grinders and lappers for finishing the piston rods. Each of the lines consists of three Cincinnati Centerless grinders and two Cincinnati lappers. Prewar they had just one line. The interesting thing about this line is the arrangement for through-feed from start to finish to effect a completely automatic cycle. It starts with an inclined magazine feed kept filled by a single operator. An air-operated injector mechanism lifts each piece from the lower end of the magazine and pushes it into the magazine feed of the first grinder. From that point on the work moves from one machine to the other on the through-feed magazine.

At the end of each of the three lines, the piston rods drop onto a conveyor and are fed directly into an enormous enclosed chromium plating machine. This machine, built by F. B. Stevens, is completely automatic in cycle from start to finish. The piston rods as they come off the Cincinnati lappers are held to a total tolerance of 0.0005 in. on the OD and a surface finish of 10 micro-inch (rms) minimum.

Next comes the first example of the closed conveyor mechanized sub-assembly lines—this one for the assembly of the piston rod, piston and valve, and rod guide. Operators on benches prepare the small parts for the assembly conveyor, the assembly then being completed on the conveyor. Outstanding feature of this line is the reduction in the number of operators required for maximum output. It also emphasizes the trend to automaticity of detail operations carried out on other assembly lines, one such example being an automatic screw driver station at which the tool is synchronized with the movement of the line and screws the guide in place as each rod passes under the tool. A little farther down the line an inspector checks the fitting with a torque wrench to assure standard tightness.

As the piston rod assembly reaches the end of the line it is lifted off and inserted in a board container traveling on the monorail. This carries the work to a small department equipped with Cincinnati Centerless grinders. Function of this operation is to grind the OD of the piston body to size and concentricity with the piston rod, thus simplifying the problem of securing concentricity of the assembly. The OD is held to a total tolerance of 0.0005 in.

We are now ready to examine the series of closed conveyor assembly lines designed for a sub-division of operations leading to the final assembly of the shock absorber. The first of these is the assembly of the piston



Side view of large W. F. & John Barnes machine specially designed for the threading of reserve tubing. The machine has a Kreuger head and an indexing fixture to hold 16 pieces at a time

One section of the piston and rod sub-assembly conveyor, described in the text, with the automatic screw driver station in the center foreground

rod and pressure tube. Before assembly begins, an inspector checks the calibration of the valve. The pressure tube is fitted over the rod and piston and then pressed onto the rod guide. This is done automatically by a small air-operated arbor press synchronized with the movement of the line. Then the cap is fitted on the end of the piston rod. Meanwhile, another line handles the reserve tube sub-assembly. Here the cap is pressed on and welded to the tubes in a battery of National Welding Machine seam welders.

The next stage is the welding of the ring to the cap on the piston rod, then loading in the conveyor with piston rod pulled out. As the conveyor moves along the pressure tube is filled with oil at an automatic filling station. To further assure complete filling, a little further down the line is a secondary filling station with two oil jets, first one then the other adding oil to the reservoir. Just beyond this point an operator inserts the lower valve and this is pressed home on another automatic press station.

The oil filled pressure tube assembly then is removed from the closed conveyor and placed on the adjacent conveyor carrying the reserve tube sub-assembly mentioned above. The pressure tube is inserted in the reserve tube, the guide rod is spun in place, and the assembly is tested again to check the calibration. It is then hooked onto the monorail conveyor for a trip through the steam washer. On the return trip the dust tube is added. Here the tube is inserted into the piston rod cap and is then seam welded in place.

The assembly is now complete but must undergo some additional inspection steps. One of these is to operate it to assure proper functioning. This is done while the unit is suspended from the monorail. Upon passing the inspection station, the monorail travels upward to the level of the large ceiling-mounted Blakeslee degreasing machine. This equipment contains an automatic paint spray section in which the entire assembly is painted with the standard color. The conveyor continues on its

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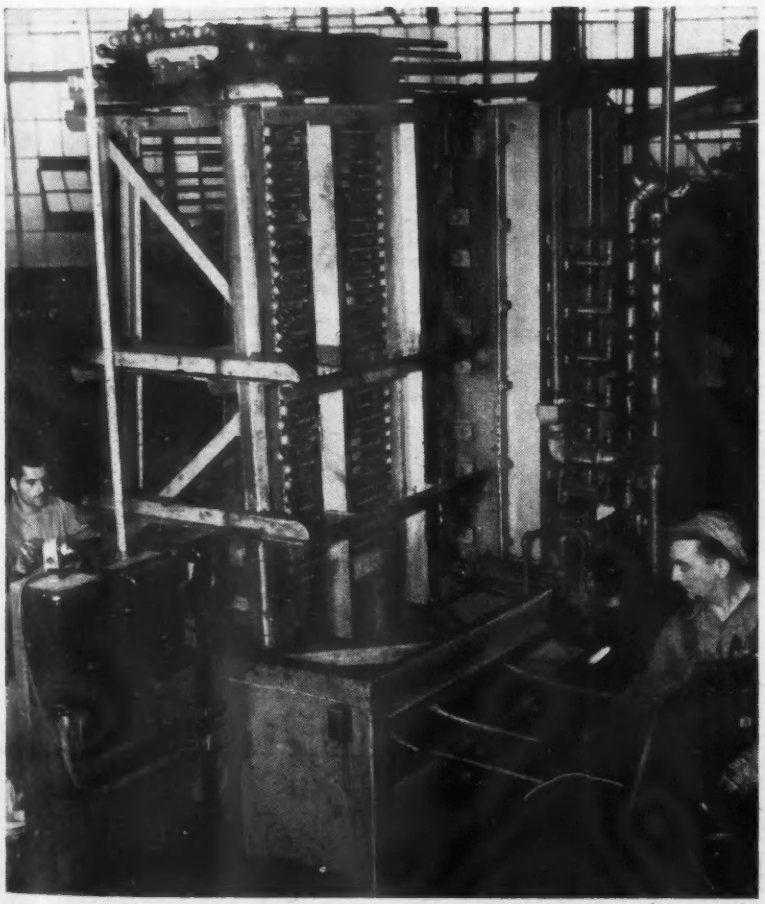

Detail of special Sales Corp. furnace for heating the ends of sway bars in preparation for upsetting. Work is fed onto the conveyor at the left, travels upward then down through the furnace and is removed by the operator in the foreground

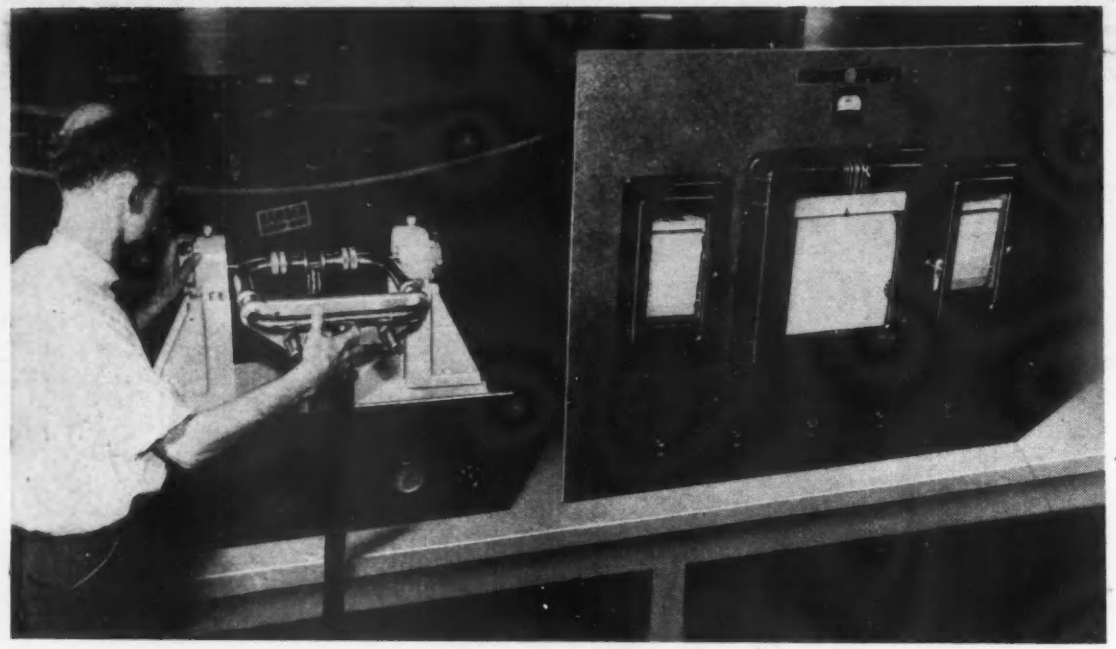

Fig. 1—Pneumatic fatigue machine is shown above testing turbine bucket. Recording instruments are mounted on accessory panel at right. This machine can produce stresses up to 100,000 psi

Pneumatic Fatigue

A PNEUMATIC testing machine has been developed which will fatigue test, in reversed bending, actual turbine buckets used in turbosuperchargers and jet engines. Gas turbine buckets have a crescent-like cross section with a finer grain structure at the points of the crescent than in the heavier midsection. This, as well as stress concentration effects, makes it impossible to arrive at a reasonable correlation between standard test specimens and actual bucket performance. Thus it is necessary to have a machine that will test the actual bucket.

Under actual operating conditions bucket vibrations are stimulated by pulsations in the gas chamber between the heater and the nozzles. The buckets are also subjected to periodic disturbing forces as they pass through regions of alternately high and low gas pressures. Since the best method of reproducing these pulsations seems to be by compressed air, a machine was built to ultilize a pulsating air stream. The device consists of a tuned air column in which the tuning is accomplished by decreasing or increasing the length of the air path much as a trombone player changes the tone of his

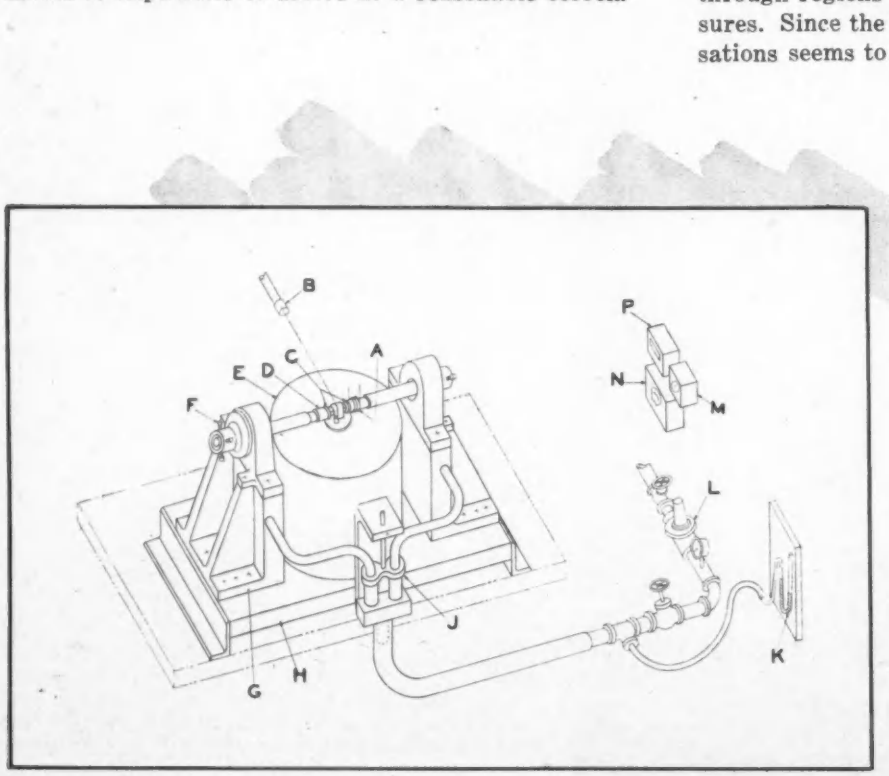

Fig. 2—Schematic diagram of pneumatic fatigue testing machine

A—Frequency pick up coil
B—Amplitude measuring telescope
C—Pistons
D—Adjustable cylinder
E—Furnace
F—Cylinder alignment
G—Pedestal
H—Base plate
J—Half wave length tuning device
K—Mercury manometer
L—Pressure control valve
M—Frequency indicator
N—Frequency meter
P—Temperature control

By F. B. Quinlan,
General Electric Co.

Testing

instrument by moving the slide. The part to be tested is placed in such a position between the two air paths that the air from the open end strikes on the upper end of the piece, causing it to vibrate. The sample vibrates until a failure occurs. This failure changes the natural frequency of the test piece, which puts it out of phase with the resonant air column. The test piece then ceases to vibrate.

As shown in Fig. 2, two cylinders (D) are connected to common manifold which receives air held at constant pressure from a pressure-control valve (L). A steady stream of air, admitted to the cylinder, increases the pressure until the piston is forced away from the cylinder. When this occurs, the gap between the piston and the cylinder increases, in turn causing the air pressure in the cylinder to drop. The spring action of the bucket, acting as a cantilever, forces the piston back into the cylinder, and the cycle is repeated. Frequency of the cycle is determined by the natural frequency of the cantilever or test piece. The amplitude of vibration is governed by the air pressure. The total air path or the distance from one cylinder mouth to the other (C around through J to C), can be made equal to one-half the wave length of sound at the frequency of the bucket assembly. The air impulses are, therefore, 180 deg out of phase. The cylinders, or air paths, are mounted on ball seats so that they may easily be aligned with the pistons. On the end of each cylinder is an adjustable sleeve, allowing the operator to back off the cylinder as the amplitude is increased.

A small coil of wire and a magnet are mounted on one of the sleeves to measure the frequency. When the bucket fails, it ceases to vibrate, and this causes a slight increase in the manifold pressure. A mercury manometer, responding to this pressure rise, closes a contact which in turn operates relays that shut the machine down and cut off a cycle counting mechanism.

It is also possible, with the aid of a contact electronic relay, to have the frequency meter act as a cut-off device. This has the added advantage of allowing the operator to set the cut-off point anywhere from the point of incipient failure to that of total fracture.

When the air pressure impulses are tuned to come at the precise instant that the piston (C) is entering the mouth of the cylinder (G), beat frequency is utilized and the driving force is increased many times. In addition the amplitude is remarkably steady and may be varied by adjusting the air pressure. Fig. 2 shows the sliding tube arrangement (J) which was developed for increasing or decreasing the length of the air path to produce a frequency equivalent to that of the sample being tested.

The change in air path length is necessary because, in going from ambient temperature to 1350 F, the bucket frequency drops from 250 c (cycles per second) to approximately 210 c (this change varies

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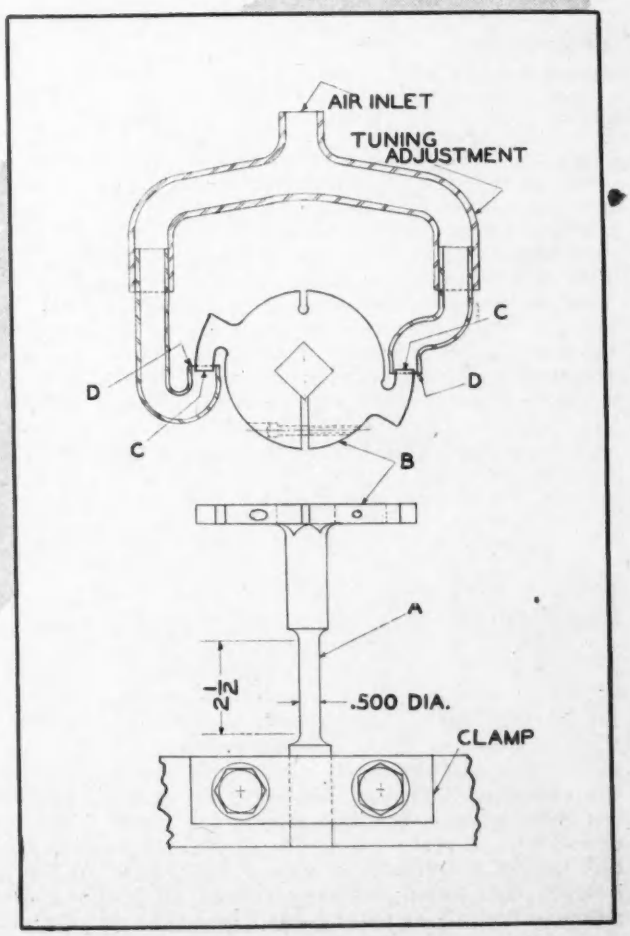


Fig. 3—Torsional fatigue machine for both room and elevated temperatures. The natural frequency of this test specimen is 230 c. Frequency is read electrically and angular displacement is read optically

A—Test piece B—Flywheel C—Piston D—Cylinder

Observations

by Joseph Geschelin

It Goes Into Fords

THE question, how much steel goes into a motor car, is answered with respect to one of them at least in a recent issue of Rouge News, published for Ford employees. The 1946 Ford takes 45 different kinds of steel for a total weight of 2401 pounds. The body, hood, and fenders account for 1000 pounds of cold rolled sheet. 680 pounds of hot rolled sheet and strip go into parts such as floor pans, frames, bracings, radius rods, axle housings, and running boards. Drive shafts and screw products require about 37 pounds of cold-drawn bars while 48 pounds of special sections go into the front axle and brake shoes. And gas tanks require 25 pounds of terne plate per car.

Powerplant Development

AN independent designer has plans for a conventional gasoline engine featuring some interesting changes. His construction contemplates elimination of the camshaft with its bearings, front drive, etc. Instead, he proposes the use of a crankshaft in which the webs on the main bearing line are of large diameter to accommodate the machining and grinding of grooved box type cams for valve actuation. Since the design exists only on paper it is too early to judge whether the construction really will result in production economy.

Coal vs. Gas and Liquid Fuel

THE recent disastrous coal strike demonstrated that a single group of workers—perhaps a single individual—could tie up our entire economy. One may well ask why our economy must continue to rely so extensively on coal. To us the situation implies a tremendous market for internal combustion engines—burning gasoline, fuel oil, or natural gas. Isolated power-plants, stand-by equipment, portable equipment of all kinds should benefit from a still wider extension of internal-combustion engines. In the next five to ten years the gas turbine may become a dominating factor in the powerplant field, including locomotive drives. To a large extent the automotive industry offers independence from the coal age.

Adopts Aluminum

ONE of the Detroit area manufacturers plans to begin production of a variety of extrusions and formed parts in aluminum for body sheet metal gaskets and interior trim items. Trim items in an anodized color finish will be groomed to compete with stainless steel.

Fission Energy

THE atomic bomb so stirred the imagination that many people have visualized atomic engines for driving motor cars, trucks, and buses. In fact some have succeeded in selling the public on the idea. At a recent meeting, Maj.-General Leslie Groves said that such developments are a long long way off. Fission of U-235 was successful under the stress of war. But under peacetime conditions he felt that progress will be slow, very slow indeed.

New Models

A PRELIMINARY survey of motor car factories indicates that 1947 models will present but little change over 1946, particularly mechanical changes. There is meager evidence also of changes in eye appeal or decoration. The situation may be likened to what existed during the war. The pressure is on production and more production. With millions of cars still to be delivered there is no time to stop for changes. Under these conditions only those changes which do not involve delays of the assembly line can be contemplated.

Shirt Sleeve Comfort

NOW that GMC has announced its heating and ventilating system for motor coaches it is obvious that the comfortizing of coaches and truck cabs is pretty well here. The new systems are designed to give a comfortable atmosphere regardless of ambient temperature; and yet keep the windows free of ice and fog. The GMC system is intended for coaches only, at this time. However, there is no reason why the same system should not be made available for truck cabs at the proper time. Interesting feature of the GMC system is provision for automatically maintaining engine temperature at a reasonable level even while the vehicle is parked in the open in cold weather. This is a boon in winter operation, makes starting a simple matter, saves wear and tear and batteries.

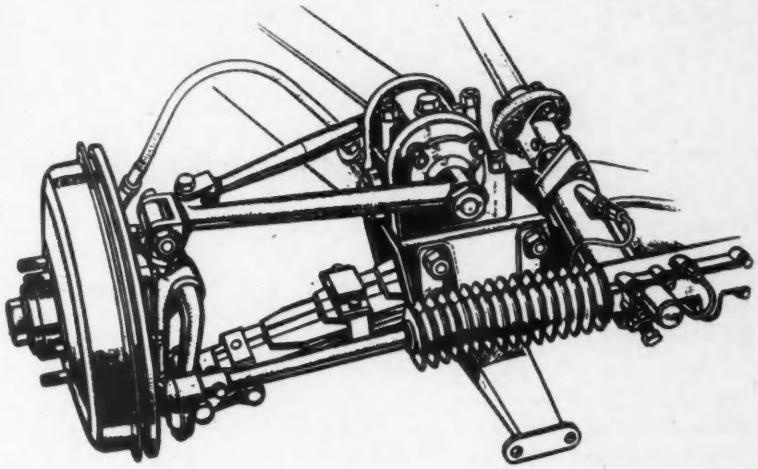
New Electric Tachometer

A simple electric tachometer which will record machinery shaft speeds from 300 to 6000 rpm has been developed at the U. S. Naval Research Laboratory to replace a mechanical fly ball tachometer which indicated the frequency vibration of a mechanical vibration test table, but was not accurate at low vibration frequencies and could not be suitably adjusted. The tachometer unit incorporates a cam attached to the drive shaft and a cam contactor that actuates a set of ignition contacts as the shaft rotates. The opening and closing of the contacts charges and discharges a condenser. The condenser current is rectified and applied to a damped milliampere meter calibrated in revolutions per second. The current through the meter is directly proportional to the number of contacts per second and therefore measures the rotational speed of the shaft. The unit uses about 10 watts of ordinary 60 cycle alternating current and needs no batteries. In operation the electrical components of the device may be placed any distance from the cam contactor.

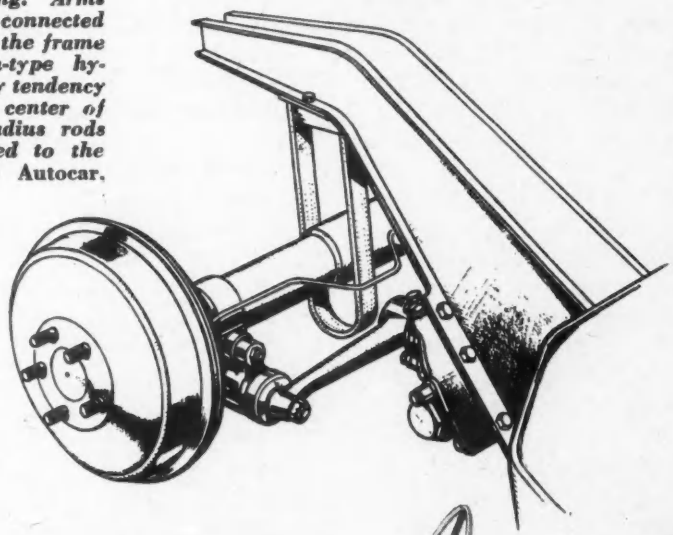
British Aircraft Firm

Enters Automotive Field

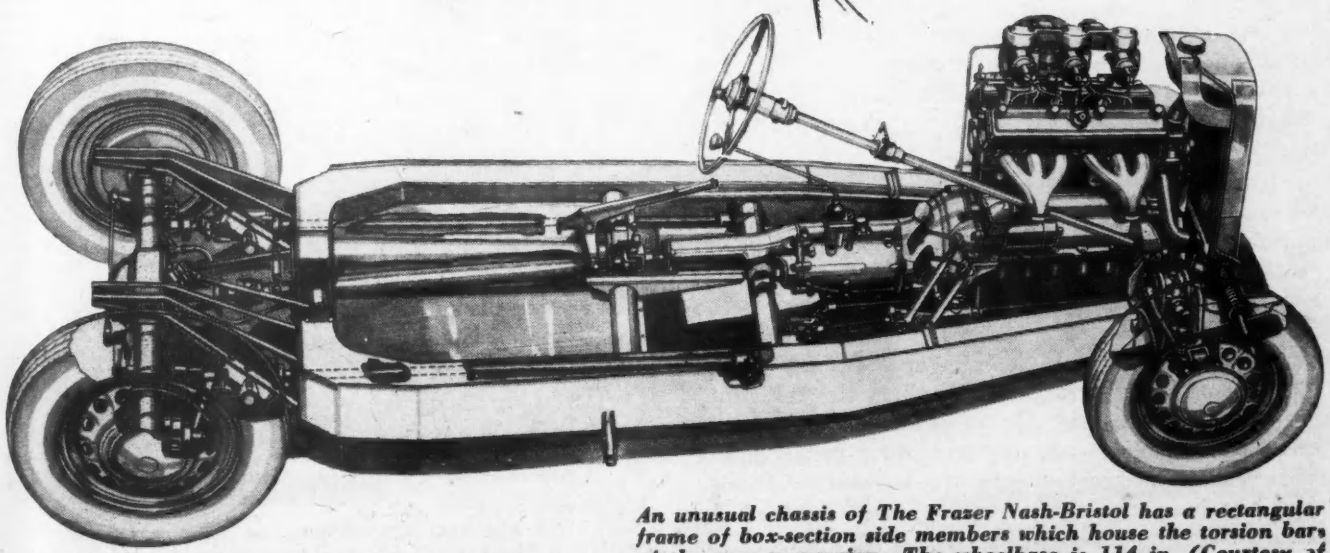
ENTRY of the Bristol Aeroplane Co., Ltd., Great Britain, into the passenger car manufacturing field was marked by the recent introduction of the 1947 Frazer Nash-Bristol automobile. Interesting design details of this new car, illustrated here, include independently sprung front wheels, rear suspension system of torsion bars and hydraulic dampers, and a massive but lightweight rectangular section box girder frame. The power plant is a six-cylinder overhead valve engine of 120.3 cu in. displacement, with 2.6 in. bore and 3.78 in. stroke. It develops 100 bhp at 5000 rpm. The cylinders are cast in one block with the crankcase, and the cylinder head is aluminum with hemispherical combustion chambers. Light allow forged pistons are used. For carburetion, three downdraft carburetors are mounted on top of the engine to feed the almost vertical intake passages in the cylinder head. A single air silencer and cleaner is connected to the three carburetors by an overhead manifold.



The front suspension unit of the Frazer Nash-Bristol consists of a single transverse leaf spring and two wishbone brackets which form part of the hydraulic damper located on the front end of the frame. The rack of the rack and pinion steering gear is spring loaded to prevent backlash. The steering tie-rod is divided and connected at its center to the rack. (Courtesy of The Autocar, *London.)*



The rear axle is semi-floating. Arms move with the axle and are connected to torsion rods running along the frame and to double-acting piston-type hydraulic dampers. To check any tendency for sideways movement, the center of the axle is controlled by radius rods pivoting on spindles attached to the frame. (Courtesy of The Autocar, *London.)*



An unusual chassis of The Frazer Nash-Bristol has a rectangular frame of box-section side members which house the torsion bars of the rear suspension. The wheelbase is 114 in. (Courtesy of The Autocar, *London.)*

Balance Conditions in

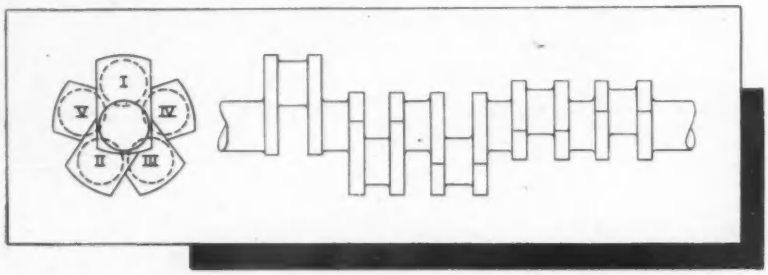


Fig. 1—Five-throw crankshaft.

FOUR-STROKE single-row radial engines always are designed with an odd number of cylinders, because that is the only way in which a uniform spacing of explosions can be obtained. Four-stroke in-line engines, on the other hand, are ordinarily built with an even number of cylinders, usually either four, six, or eight. It is possible to use an odd number of cylinders also in the latter type of engine, and some three-cylinder models were produced in the early years of the industry. The reason an even number is generally preferred for in-line engines is that it eliminates rocking couples.

In the selection of cylinder numbers and cylinder arrangements the designer usually aims at three principal objects, namely, a uniform (or at least nearly uniform) spacing of explosions, freedom from shaking forces, and freedom from rocking couples. With three parallel cylinders whose pistons act on cranks set at 120 deg, a uniform spacing of explosions is obtained, and there are no shaking forces, but such an engine is not free from rocking couples. With four cylinders in line and the conventional four-throw, single-plane crankshaft there also is a uniform sequence of explosions and there is no rocking couple. However, only the primary inertia forces are balanced out. The secondary inertia forces on all four sets of reciprocating parts are in phase, and therefore are not balanced.

Five-cylinder, in-line engines have not been produced in this country, at least not in quantity. A little investigation shows that with such an engine there are longitudinal rocking couples, both primary and secondary, the former having the same frequency as the crankshaft rotation, the latter twice that frequency. By the addition of a single cylinder (to make a six), all three of the requirements listed in the foregoing can be fully met, and American designers seem to have been unable to see any particular merit in the five cylinder construction. However, the five-cylinder type has been used to a certain extent abroad by manufacturers of high-speed Diesel engines, which would indicate that the rocking couples which they give rise to cannot be excessive. In a list of British marine engines published just prior to the outbreak of World War II no less than seven different makes of five-cylinder engines were included, three of the manufacturers being Ricardo licensees. It is my impression that a number of German manufacturers of high-speed Diesel engines also have produced five cylinder models, but I am not in position to name them. One reason why the five-cylinder design is used more extensively in the Diesel than in the gasoline-engine field is that in the former it is customary to produce lines of engines with cylinders of the same size but different numbers, usually starting with either one, two, or three. The inclusion of a five-cylinder model then gives the manufacturer one additional engine size at relatively little outlay for additional production equipment.

The object of this article is to investigate the balance conditions in five-cylinder in-line engines both qualitatively and quantitatively. It will first be shown that in a five-cylinder, in-line engine with equal spacing of the five cranks (Fig. 1) there are no vertical shaking forces (unbalanced inertia forces). The reciprocating parts of a combustion engine are subject to both primary and secondary inertia forces, the first having a frequency equal to the speed of rotation of the crankshaft, the second twice that frequency. Both inertia forces can be represented by

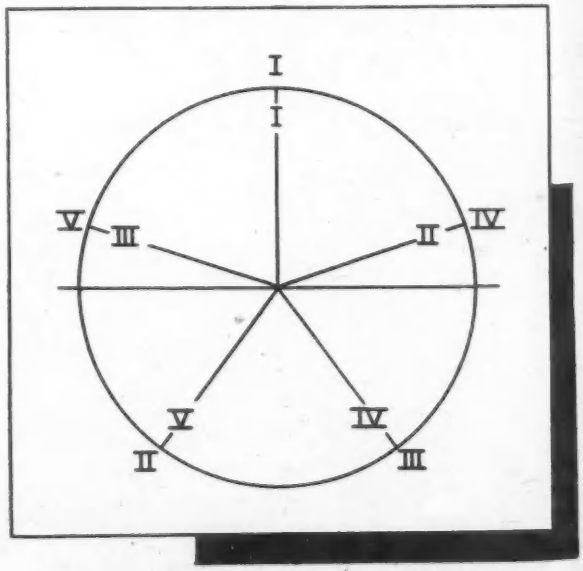


Fig. 2—Phase diagram of primary (outside numerals) and secondary (inside numerals) inertia forces on the different cranks.

Five-Cylinder In-Line Engines

By P. M. Heldt

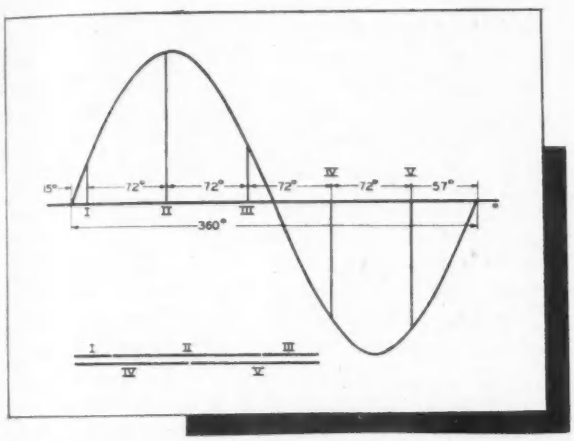


Fig. 3 — Showing that upward and downward inertia forces are equal for all crank angles.

sine or cosine curves, and the primary inertia force on the reciprocating parts of a single cylinder may be represented by the equation

$$f = c \cos \theta,$$

c being a constant depending on the weight of the reciprocating parts, the length of stroke, and the rpm of the engine; and θ, the crank angle, which is measured from the top center position of the crank. Since the five cranks are equally spaced, each set of reciprocating parts follows the preceding one at an angular interval of 72 deg. Therefore, if the primary inertia force due to one set of reciprocating masses is represented by $c \cos \theta$, that due to the set next in order is $c \cos (\theta - 72 \text{ deg})$, that due to the next set, $c \cos (\theta - 144 \text{ deg})$, and so on. Both the primary and secondary inertia forces are a maximum in the upward direction when the crank is in the top center position. The crank angle then is zero and the cosine of 0 deg is 1.000. During the revolution of the crankshaft the primary inertia force varies in direct proportion to the cosine of the crank angle. The momentary primary inertia force due to all five sets of reciprocating parts together is given by the equation.

$$F = c\,[\cos \theta + \cos (\theta - 72 \text{ deg}) + \cos (\theta - 144 \text{ deg}) + \cos (\theta - 216 \text{ deg}) + \cos (\theta - 288 \text{ deg})]$$

By now making use of the expression for the cosine of the difference of two angles A and B, viz.,

$$\cos (A - B) = \cos A \cos B + \sin A \sin B,$$

we get the following expression

$$F = c\,(\cos \theta + \cos \theta \cos 72 \text{ deg} + \sin \theta \sin 72 \text{ deg} + \cos \theta \cos 144 \text{ deg} + \sin \theta \sin 144 \text{ deg} + \cos \theta \cos 216 \text{ deg} + \sin \theta \sin 216 \text{ deg} + \cos \theta \cos 288 \text{ deg} + \sin \theta \sin 288 \text{ deg})$$

This can be simplified to

$$F = c \cos \theta\,(1.00 + \cos 72 \text{ deg} + \cos 144 \text{ deg} + \cos 216 \text{ deg} + \cos 288 \text{ deg} + c \sin o\,(\sin 72 \text{ deg} + \sin 144 \text{ deg} + \sin 216 \text{ deg} + \sin 288 \text{ deg}).$$

The values of the sines and cosines in the equation and their sums are given in the following table:

Angle (deg)	Cosine	Sine
72	0.309	0.951
144	—0.809	0.588
216	—0.809	—0.588
288	0.309	—0.951
Sum	—1.000	0.000

If these values are inserted in the equation for F it cancels out.

In a similar way it can be shown that the secondary inertia forces on the different sets of reciprocating masses cancel out. The phase angle of the secondary inertia force is equal to twice the crank angle, hence the phase angles are 2θ, $2\,(\theta - 72 \text{ deg})$, $2\,(\theta - 144 \text{ deg})$, $2\,(\theta - 216 \text{ deg})$, and $2\,(\theta - 288 \text{ deg})$, which in turn are equal to 2θ, $2\theta - 144$ deg, $2\theta - 288$ deg, $2\theta - 432$ deg and $2\theta - 576$ deg. But $2\theta - 432$ deg is equal to $2\theta - 72$ deg and $2\theta - 576$ deg is equal to $2\theta - 216$ deg. The phase relations of the primary and secondary inertia forces for a five-throw crank-

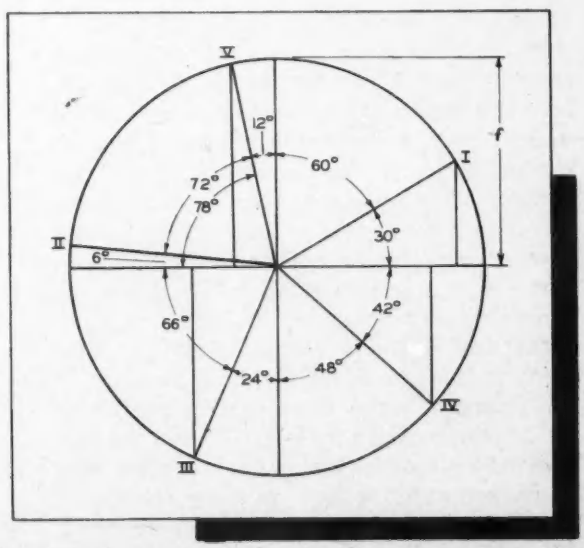


Fig. 4 — Determination of instantaneous values of primary inertia forces in the various cylinders for a crank angle of 60 deg.

shaft in which the order of crank throws in the clockwise direction is I, IV, III, II, V are illustrated in Fig. 2. Each of the five radial lines may be considered to represent either the crank indicated by the Roman numeral outside the circle or the phase of the primary inertia force acting on that crank.

Since the secondary inertia force has twice the frequency of the primary, phase differences between those of angularly adjacent cranks are equal to twice the phase differences between the primary inertia forces on the same cranks. Thus, as indicated by the Roman numerals inside the circle, the secondary inertia force on crank IV leads that on crank I by 144 deg, and that on crank III leads that on crank I

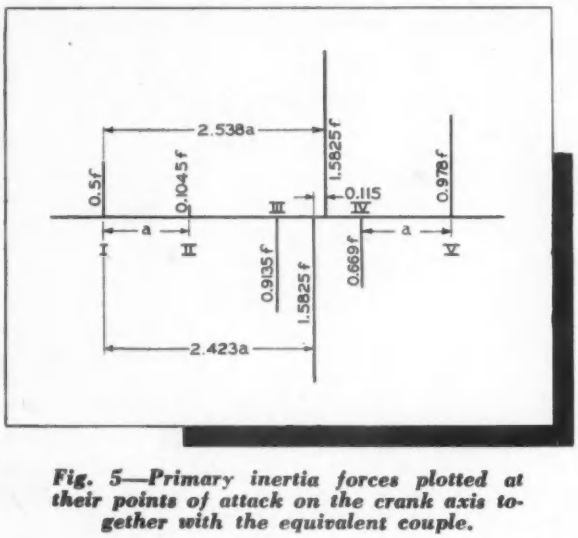


Fig. 5—Primary inertia forces plotted at their points of attack on the crank axis together with the equivalent couple.

by 288 deg. The important point is that there are equal phase differences of 72 deg between the secondary inertia forces on the five cranks. As shown analytically in the foregoing, when five harmonic forces in the same plane act on a single point they neutralize each other or cancel out.

The results thus arrived at analytically can be checked graphically by plotting the inertia force on a single set of reciprocating masses over a base line representing the circumference of a circle (or the time of one cycle). This is done in Fig. 3, which shows the cycle through which the primary inertia force passes during one crankshaft revolution. For any particular crank throw we can select any point on the base line (any crank angle) and a vertical line from that point to the sine curve will be a measure of the primary inertia force on that particular set of reciprocating masses. To find the corresponding inertia forces on the other sets of reciprocating masses we draw other verticals at points of the base line separated by 72 deg. In Fig. 3 one of the verticals is drawn at 15 deg crank angle, and this brings the others to 87 deg, 159 deg, 231 deg and 303 deg. In order that there may be no shaking forces the aggregate length of the verticals extending up from the base line (upward forces) must be equal to the aggregate length of the verticals extending down from the base line (downward forces). Fig. 3 shows that they are.

In order to obtain equal spacings of explosions and eliminate shaking forces in a five-cylinder, in-line engine it is only necessary that the five cranks be equally spaced angularly. In discussing crank layouts and crank positions it is usual to consider crank I (at the forward end of the engine) in the top center position. From the standpoints of spacing of explosions and absence of shaking forces it is immaterial in what order the different cranks follow one another as one passes around the circle in the clockwise direction. However, since the different inertia forces do not act in the same transverse plane but in planes separated by a distance equal to the center distance between cylinders, there will be a rocking effect, and this effect is influenced by the order in which the different crank throws follow one another.

By the theory of choice it can be shown that 24 different designs of five-cylinder crankshafts with equal spacing of crank throws are possible. Assuming crank I to be at 0 deg, crank II may be either at 72 deg, 144 deg, 216 deg or 288 deg. With crank II in any one of these positions crank III may be in any one of three different positions. For instance, with crank II at 72 deg, crank III may be at either 144 deg, 216 deg or 288 deg. Evidently, any of the three possible positions of crank III may be combined with any of the four possible positions of crank II, and this already gives 12 different combinations. But with cranks I, II and III in definite positions there remains a choice of two different positions for crank IV, and each of these may be combined with any of the 12 positions already referred to. Hence the total number of possible combinations is 24.

With all of these 24 designs we obtain equal spacing of explosions and freedom from shaking forces, and if any of them are better than the others it must be because with them the rocking effects are smaller.

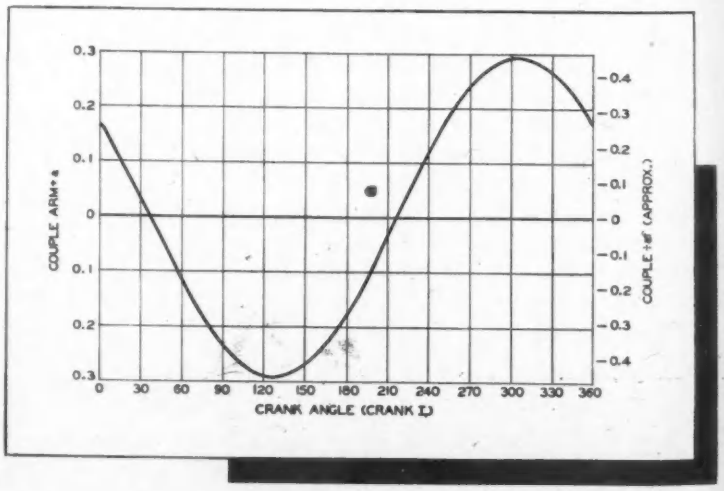


Fig. 6—Curve of primary couples and couple arms.

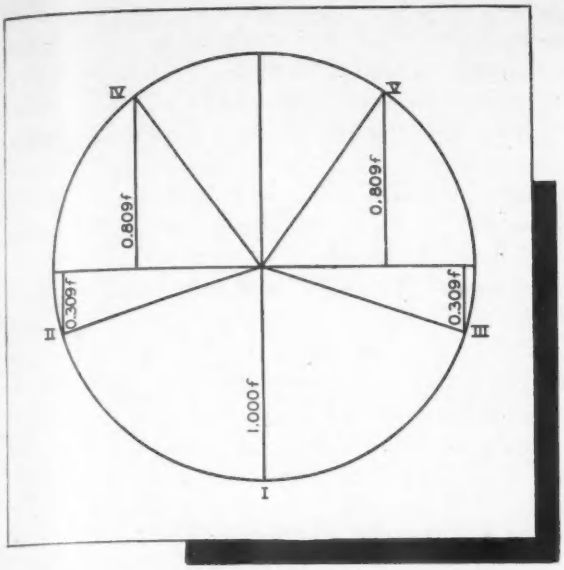


Fig. 7 — Determination of instantaneous values of secondary inertia forces in the various cylinders for a crank angle of 90 deg.

The rocking effects, of course, are due to the inertia forces, which act along the cylinder axis and therefore are distributed over the length of the crankshaft. Since there are primary and secondary inertia forces, there are also primary and secondary systems of rocking forces which must be considered separately. In a conventional engine in which the connecting-rod center-to-center length is equal to twice the stroke, the primary inertia force is four times as large as the secondary inertia force, hence it is particularly important to seek a crankshaft layout that will reduce the primary system of rocking forces or, rather, the equivalent couple. At any given moment (for a given crank position) the system of forces is equal to a couple, and since the couple varies in magnitude and changes its direction twice during every cycle, the general effect is that of a rocking couple.

When we look at a five-throw crankshaft from the side, we see that crank III must be near the transverse axis around which any rocking motion of the engine must take place, and the inertia forces on this crank therefore cannot have a very large effect on the rocking motion. There are two cranks near each end of the shaft, and the rocking effect evidently would be a maximum if both of these cranks were in the same plane so that their inertia forces would be in phase. The farther these two cranks are apart angularly the smaller will be the resulting rocking couple. There are only two possible angular spacings between the cranks at one end of the shaft, 72 and 144 deg. If the spacing is 72 deg the primary inertia forces in the two end cylinders will be in the same direction most of the time, while if they are spaced 144 deg they will be opposed most of the time. Therefore, the primary equivalent rocking couple will be least if the two cranks at each end of the shaft are separated angularly by 144 deg. This eliminated 16 of the possible crankshaft layouts, leaving eight, the crank positions of which are given in the following table:

Ang. Pos.	0°	72°	144°	216°	288°
Shaft 1	I	IV	II	III	V
Shaft 2	I	V	II	III	IV
Shaft 3	I	IV	II	V	III
Shaft 4	I	V	II	IV	III
Shaft 5	I	III	IV	II	V
Shaft 6	I	III	V	II	IV
Shaft 7	I	IV	III	II	V
Shaft 8	I	V	III	II	IV

In the analysis of the equivalent rocking couples produced by the inertia forces we will use shaft 7 as an example.

The primary inertia forces for any crank position can be found by drawing five radial lines at angular positions corresponding to that crank position and then drawing perpendiculars to the horizontal line through the center point. In Fig. 4 this is done for the position where crank I is 60 deg past top center. The radius of the circle represents f, the maximum value of the primary inertia force due to a single set of reciprocating parts. Its value can be found from the equation

$$f = W\,l\,n^2/70480 \text{ lb},$$

where w is the weight of the reciprocating parts in lb; l, the length of stroke in in.; and n, the crankshaft speed in rpm. From the drawing it is found that the momentary primary inertia forces in the various cylinders are as follows:

Cylinder 1, f sin 30 deg = 0.5 f

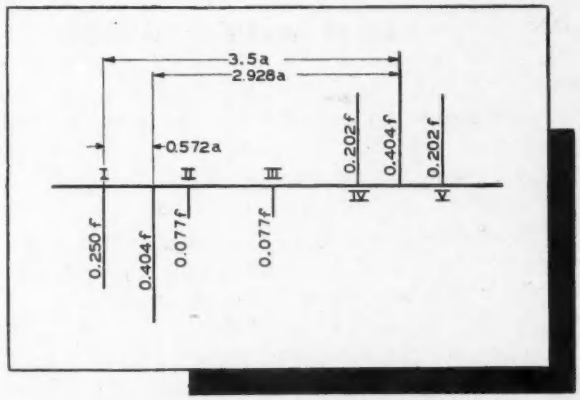


Fig. 8—Secondary inertia forces plotted at their points of attack on the crank axis together with the equivalent couple.

Cylinder II, f sin 6 deg = 0.1045 f
Cylinder III, $-f$ sin 66 deg = -0.9135 f
Cylinder IV, $-f$ sin 42 deg = -0.669 f
Cylinder V, f sin 72 deg = 0.978 f

In Fig. 5 the horizontal line represents the crankshaft axis, and vertical lines representing the primary inertia forces due to the parts in the different cylinders are drawn at the points where they act on the crankshaft, the distance a between these forces being equal to the cylinder center distance.

It is quite apparent from the drawing that at least with the crank in this position the primary couple must be relatively small, because the two forces at opposite ends of the shaft are in the same direction

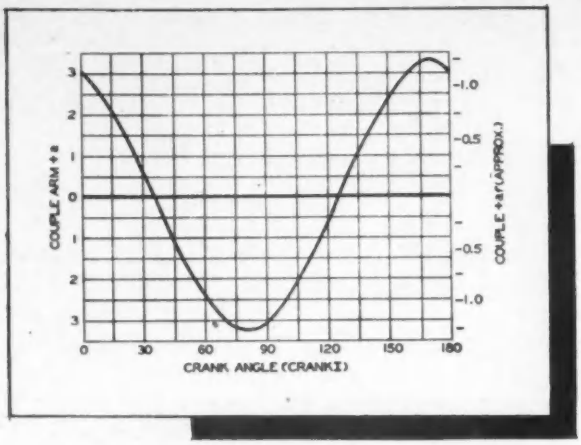


Fig. 9—Curve of secondary couples and couple arms.

and two of the intermediate forces in the opposite direction. The sum of the upward forces, 1.5825 f, is equal to the sum of the downward forces, which again proves that there is no shaking force in the engine.

The three upward forces can be replaced by a single equivalent force, equal to the sum of the individual forces, and the same can be done with the two downward forces. These two equivalent forces when multiplied by the distance between them give the equivalent couple. The points of action of the equivalent forces on the crankshaft can be found from the fact that the moment of one of the equivalent forces around a given axis must be equal to the sum of the moments of the two or three forces which it replaces, around the same axis. We will take moments around a horizontal axis through the center of crank I. The moment arm then is equal to a for the force acting on crank II, $2a$ for that on crank III, $3a$ for that on crank IV and $4a$ for that on crank V. After having found the moments of the individual upward forces we add them together, dividing the sum of the moments by the equivalent upward force, we get the distance of the point of action of the equivalent upward force from the center of crank I:

$$\frac{(a\times 0.1045\,f)+(4a\times 0.978\,f)}{1.5825\,f}=2.538a.$$

In a similar manner we get for the distance from the center of crank I to the point of action of the downward equivalent force

$$\frac{(2a\times 0.9135\,f)+(3a\times 0.669\,f)}{1.5825\,f}=2.423\,a.$$

The difference between these two distances, $0.115a$, is the length of the couple arm, and the value of the couple therefore is

$$1.2525\,f\times 0.115\,a=0.182\,a\,f.$$

This is a very small couple, being approximately equal to that which would be produced by two opposed cylinders of the same size as those of the five-cylinder engine, acting on cranks with a center spacing equal to less than one-fifth the distance between cylinder axes in the five-cylinder. However, the figure thus arrived at applies only to a given crank angle, 60 deg past top center, and gives no idea what the maximum value of the couple may be. To find that, it is necessary to calculate the couples for a considerable number of crank angles, distributed over the entire circle, and then plot couples against crank angles. This has been done in Fig. 6. It should be pointed out here that at 60 deg the downward equivalent force acts at a point on the crank axis which is closer to crank I than the point at which the upward equivalent force acts, hence the tendency is to pull down the engine in front. Couples plotted below the O-O line tend to pull down the engine in front, while those above that line tend to raise the front.

In Fig. 6 the beginning of the crank-angle scale corresponds to the crank position for which crank I is in top center. The primary couple is there positive (upward in front); it passes through zero at 36 deg, attains its maximum negative value at 126 deg, passes through zero again at 216 deg and attains its maximum positive value at 306 deg.

We now take up the secondary rocking couple and calculate it for an engine with the same crankshaft layout, in which the cranks follow one another in the order, I, IV, III, II, V in the clockwise direction. The secondary inertia force is at its maximum when the crank is in top center (0 deg) and is then directed upwardly, the same as the primary. Crank IV precedes crank I by 72 deg, and there is a similar phase difference between the primary inertia forces on these cranks, but the phase difference between the secondary inertia forces on them is twice as great and equal to

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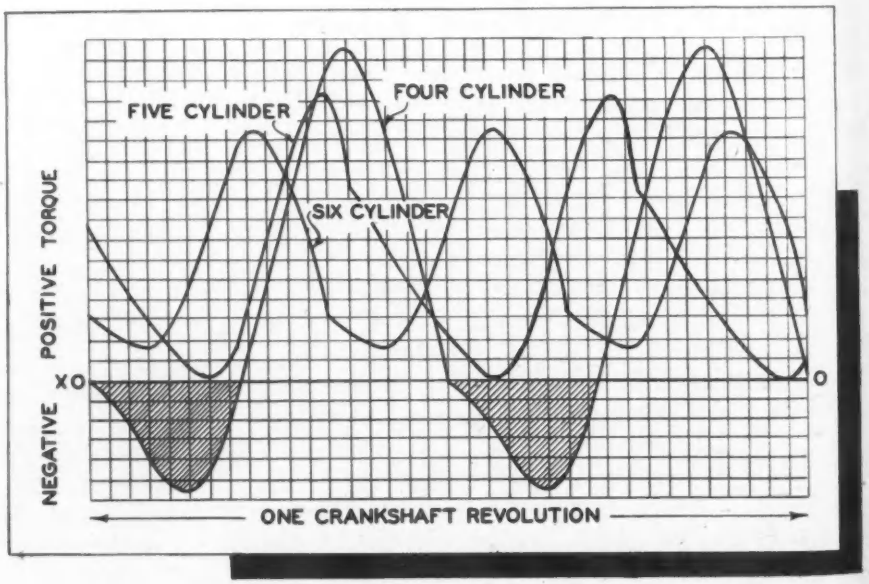


Fig. 10—Crank-moment diagrams of four-, five-, and six-cylinder engines.

Problems in the Selection of

Aircraft Accessory Equipment

By E. W. Anger, Jr.
Lockheed Aircraft Corp.

THE aircraft engineer's problem of selecting appropriate accessory equipment is a concomitant outcome of newly designed and available equipment fostered by the war. It became necessary for the engineer to select required units from incomplete engineering data and sales promotional information issued by many new and inexperienced manufacturers of accessory equipment. Complete engineering data, such as attachments, mounting dimensions, external size, test reports showing power input, power output, efficiency, duty cycle and operational life, and certified or photostatic copies of evidence of conformance with Army or Navy specification, were lacking in many cases. When manufacturers were questioned concerning the absence of this essential information they indicated that it was because of the rush of business and the government restrictions on paper. However, sufficient engineering data should have been prepared in order that the release of aircraft fabrication and installation drawings would not be delayed due to the lack of installation information for a piece of equipment.

Another situation that began to plague the aircraft designers during the increased tempo of building combat airplanes was the selection of alternate equipment. If a manufacturer were unable to deliver, the engineer often had to change his selection to other equipment which could be purchased from more than one company and still be interchangeable, installationwise and ratingwise. The Army and Navy requirement that at least three quotations be received before placement of a purchase order also burdened the engineer with investigating and approving alternate sources of supply.

Following V-J Day many aircraft equipment manufacturers decided that the volume of airplanes to be produced during the next few years would not be sufficient to justify their continuation in the aircraft accessory field. Many of the equipment manufacturers failed to give the aircraft industry any notice of their decision which resulted in many units of non-available equipment being designed into new airplanes and into converted military airplanes for commercial use. The unavailability of the equipment was sometimes not discovered until an attempt was made to purchase the units, necessitating costly hours of re-searching technical data, selecting a substitute unit, and redesigning the installation, with attendant production delays.

Recently it has been estimated that approximately 40 to 50 per cent of the cost of a transport type airplane is spent for complex equipment, including engines and propellers. This means that considerable study and investigation is required to evaluate and select the equipment best suited for the operation to be performed.

The airlines insist that one manufacturer's equipment be installed throughout their lot of airplanes because of the resulting difficulties in provisioning for replacements and spares. This makes it imperative that the engineer select the latest and most reliable equipment available. Information concerning accessory equipment usually available to the aircraft engineer is in the form of catalogs, leaflets, manufacturers' blueprints, trade magazines and verbal information obtained from manufacturers' local representatives or agents. Catalogs generally do not contain sufficient technical data for the engineer to make his selection. In many cases the catalog is mostly sales promotional material with only vague and enthusiastic facts as to how the equipment portrayed will perform. The catalog should not only itemize the equipment available from any one manufacturer, but should list complete technical data concerning the units shown. Sales promotional material need not be eliminated but should be kept to a minimum.

It is common practice for a manufacturer to assign the compiling, editing and issuing of a catalog to his sales department or an outside advertising firm. If this is done is should be mandatory that all final copy for the new catalog be submitted to the engineering department to determine if the catalog writer's praises

(*Turn to page* 86, *please*)

Battery Operated Machines Speed Multi-Spot Welders

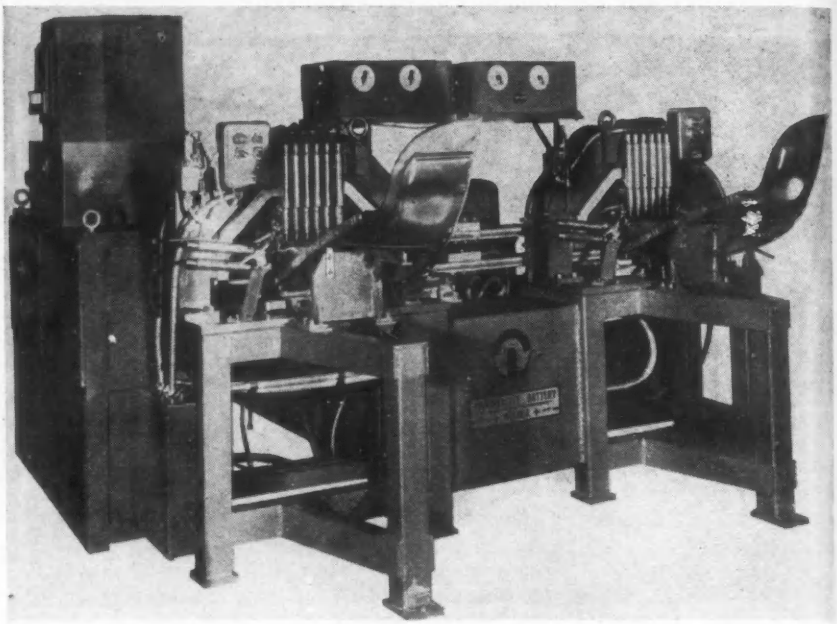
MULTI-SPOT WELDING, increasing popular in automotive plants for the assembly of sheet metal parts, due to the increased productivity per machine hour, has taken another step forward with the introduction of battery-powered machines for this type of work.

Advantages of the battery-operated multi-spot welders are decreased line load and ability to perform a greater number of welds simultaneously. These two advantages interlock to some extent since simultaneous welding of individual spots would impose high loads on electric power lines in the plant.

An example of the application of battery machines to automotive production is in the welding of dust shields assemblies in the plant of one of the "big three." The operation calls for 11 spot welds.

The machine, designed and produced by Progressive Welder Co., Detroit, for this purpose is shown in the illustration. It is a double-station machine designed for handling both right and left dust shield assemblies. Batteries (16 cells—8 volt) are contained in a housing in the rear center of the machine. At the left of the machine is a group of package-type chargers, above which is the charger control. Machine controls (timers) are shown in the center (top) of the machine. A total of only 30 kva—balanced on three phases—is required to keep the batteries charged.

In operation, only two "shots" from the batteries are required to complete all eleven welds. The first "shot" produces six welds simultaneously, while the second produces the other five welds. Production with this setup is 300 assemblies per hour, with two men to load and unload. With the previous setup, the two men could produce only about 125 dust shield assemblies per hour. Interesting also is that the ease of loading the machine actually reduces the amount of effort required from the individual operator despite the increased productivity. Material is 20 gage cold rolled steel. The parts are dropped into the fixture and the "start" button is pressed. All electrodes then come down on the work, the electrodes themselves acting as clamps. On completing of the cycle electrodes retract to permit removal of the assembly.

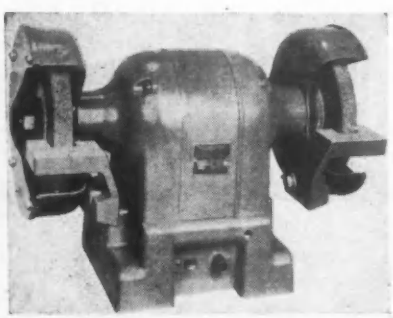


Battery-powered multi-spot welding machine made by Progressive Welder Co.

Heavy-Duty Bench Grinder

LATEST addition to the line of the Black & Decker Manufacturing Co., Towson 4, Md., is a completely new six-in. heavy-duty bench grinder. Its housings of die-cast zinc are said to improve working clearances and reduce weight. Steel wheel guards and covers will accommodate a standard three-section wire wheel brush without any change in the guard. Fitting around the grinding wheel for improved support in tool sharpening are adjustable U-shaped tool rests. The two-pole push button switch is recessed in the housing to prevent accidental contact yet it remains easy to reach. On the face of the grinder base a machined hole is provided for mounting attachments commonly used on bench grinders.

The new six-in. heavy duty bench grinder can be bolted to a bench or mounted on a new streamlined pedestal. Standard equipment includes two grinding wheels-medium grade for rough fast work, fine grade for finish grinding and tool sharpening.

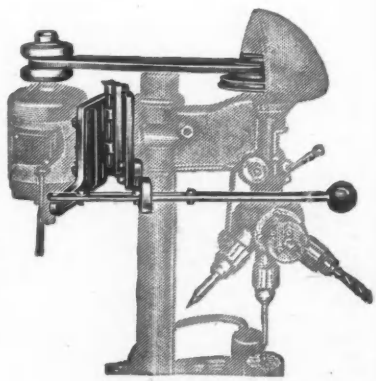


Black & Decker bench grinder

Quick Method of Obtaining Correct Drilling Speeds

CHICAGO DRILLET CORP., 1729 N. Winchester Ave., Chicago 22, Ill., is making the Instant Speed Changer, a quick, easy method of obtaining correct drilling and tapping speeds on drill presses without having to change belts or stop motor.

The Speed Changer can be set for any range of speeds required. A standard drill press equipped with Speed Changer and a standard four-step cone V-belt pulley will have a speed range from 435 rpm to 4550 rpm. The Speed Changer is engineered so that all steps of the pulley can be used.



Instant speed changer

NEW Production and Plant EQUIPMENT

Automatic plug sizing is accomplished by a plug gage, mounted in the work spindle, which automatically checks the bore size after each pass of the grinding wheel. As the plug gage enters the bore, the machine automatically stops grinding and the wheel withdraws from the bore ready for loading of the next workpiece.

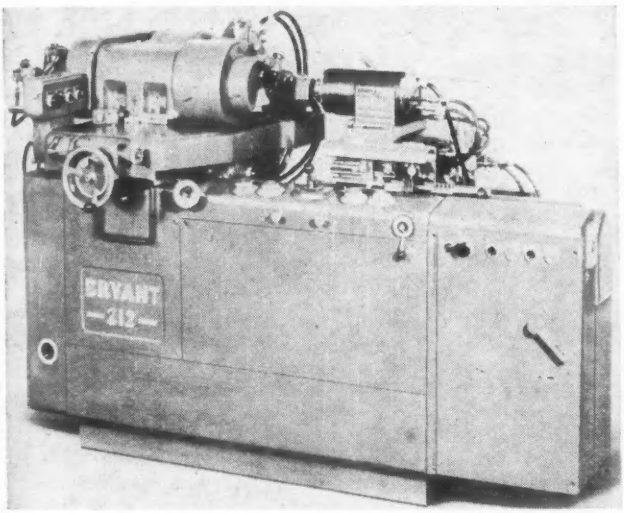
THE NO. 212 BRYANT GRINDER is designed by the Bryant Chucking Grinder Co., Springfield, Vt., to fill the need for a precision high production automatic internal grinder requiring minimum operator attention.

Maximum rigidity is provided in the design of this machine by the Bryant cylindrical slide construction. The slide bar, to which the wheelslide is attached, is supported on two bearings in the base of the machine. A shoe beneath the rear of the wheelslide follows a hardened and ground control plate. The wheelslide is thus supported at three points, each of which is provided with pressure feed lubrication.

complished electrically so that the cycle can be readily changed to suit varying working requirements.

Three methods of automatic sizing can be provided for this machine. The basic machine equipped so that changeover from one method to either of the others can be accomplished by the addition of the sizing equipment.

Sizing from the truing diamond is accomplished by predetermined advance of the wheel beyond the wheel truing position, which is performed between the rough and finish grinding positions of the cycle. Wheel wear is automatically compensated for by the machine.



Bryant No. 212 automatic internal grinder

The machine has a 9-in. swing inside the standard water guard and a 12-in. total wheelslide traverse. The cross feed is obtained by lateral motion of the workhead which is supported by specially designed and anti-friction bearings of the roller type. The machine is suited for grinding work with bores from 5/16 in. diameter up to 3½ in. in diameter, and the grinding traverse permits grinding of 3 in. bore lengths. For the smaller ranges of bores, Bryant Hi-Frequency wheel spindles operating up to 100,000 rpm may be used. A variety of standard or special tooling may be used in conjunction with the machine to satisfy the particular needs of the customer.

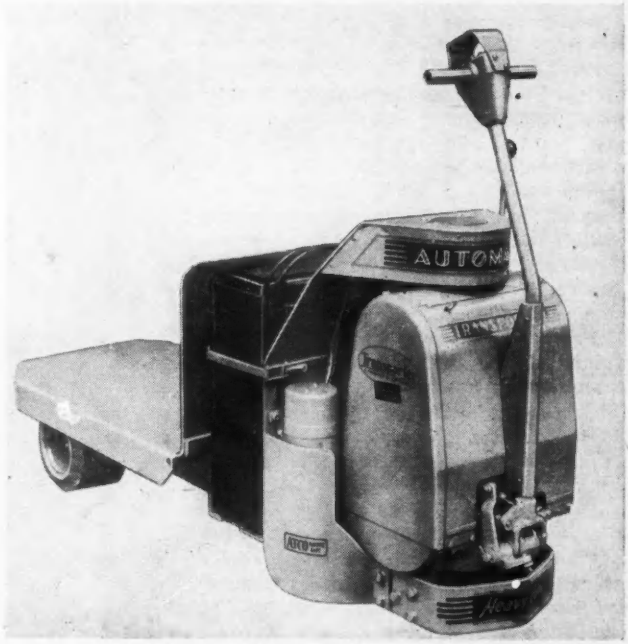
The various movements of the machine are hydraulically operated to afford flexibility of operation between the various units. Cycle control is ac-

FEATURING a new lift, and for the first time alternate types of lift—Atco electric lift and Atco foot lift—the 1947 models of the Transporter motorized hand truck have just been introduced by Automatic Transportation Co., 149 W. 87 St., Chicago 20, Ill. The 1947 Transporter with Atco electric lift is a new addition to Automatic's line. It is said to be the first electric-lift hand truck so efficient it can operate with a standard 11-plate battery.

To simplify operation of the new Atco electric lift model, all controls—forward and reverse, speed, lift, steering and brake—are so arranged that they may be regulated by one hand and operated virtually simultaneously. Accessibility is an additional advantage of the new electric lift. Guards are designed so as to protect the lift components from damage during operation and yet leave them accessible for maintenance.

Feature of both the new electric lift and foot lift Transporters is a new double-position brake, which is applied either by raising or lowering the guide handle, thus providing steering and braking leverage simultaneously for operations on ramps.

Combination of the new brake and one-hand controls with electric lift enables an operator to guide the electric-lift Transporter into a skid or pallet, brake the truck, lift the load, and reverse direction all in one motion with-



Transporter motorized hand truck

Ozalid Streamliner

liner to its line of positive printing, dry developing machines. With this new machine anything drawn, typed, printed or photographed on translucent material is reproduced as an easier-to-read, positive (not negative) copy. No intermediate steps are required. No chemical baths or inks are used. Prints are delivered completely dry, ready for immediate use after only two operations—exposure and dry development. The lines and images on originals can be reproduced in black, blue, red, sepia or yellow—on paper, cloth, foil, film, or plastic.

The Streamliner is of aluminum-steel construction. Even nuts and bolts throughout machine are non-corrosive. A wide feedboard provides adequate working space. It is made of aluminum which eliminates warpage. The Hammerloid finish protects outside surfaces from scratching and abrasion. Is painted attractive gray, while all operating controls are of colored red plastic.

out stopping. The controls are so coordinated and the lift action so fast that the operator can raise the load with a motion of the forefinger while moving his thumb from the "Forward" to the "Reverse" button. Brake and direction are meanwhile controlled by the position of the guide handle.

The companion model, that with Atco Foot Lift, is basically similar to Automatic's standard 1946 model Transporter, with the addition of the double-position brake.

Both the electric and foot lift Transporters will be made in Automatic's three standard units—4000 and 6000-lb load capacity platform models and 4000-lb capacity pallet model.

A COMPLETE new line of flash-welding equipment has been announced by Sciaky Bros., Chicago. Welders range in size from 75-kva for .90 sq in. mild steel up to large, completely automatic machines rated 500-kva for capacities up to 5 sq in. Included are mitre joint welders for production of steel and aluminum window frames, door sash, etc., for the building trades. Flashing and upsetting on smaller welders is by means of a hand lever. Large welders may be either all power-operated, or a combination of hand lever flashing and power upsetting. Several advanced design features are incorporated in the line.

Frames are designed as a self-contained beam with conductors from transformer to dies outside the frame. This eliminates need for a weakening cutout within the frame and allows transformer to be protected from flash sparks.

Platens move on a wide, rigid T-shaped bed with a narrow guiding key. Accurate guiding is assured with stresses distributed over large flat bearing surfaces.

Clamps are actuated by a high-pressure, booster-supplied hydraulic system. This allows the use of small-diameter cylinders so that the direction of force can be directly over the clamps.

On the large power-operated machines, flashing and upsetting is independently controlled. Both platens are moved by an air cylinder driving a wedge-shaped cam between rollers. These can be controlled so that it is seldom necessary to change cams.

When welding tubes over 3 in. OD a dual transformer supplies heat to both upper and lower dies, assuring perfect distribution of heat.

Heavy-duty machines can be equipped with synchronous timing control, post-heat current and phase shift heat control to permit welding of aluminum alloys, high carbon and aircraft steels.

OZALID, Division of General Aniline and Film Corp., Johnson City, N. Y., has added the Ozalid Streamliner to its line of positive printing, dry developing machines. With this new machine anything drawn, typed, printed or photographed on translucent material is reproduced as an easier-to-read, positive (not negative) copy. No intermediate steps are required. No chemical baths or inks are used. Prints are delivered completely dry, ready for immediate use after only two operations—exposure and dry development. The lines and images on originals can be reproduced in black, blue, red, sepia or yellow—on paper, cloth, foil, film, or plastic.

The Streamliner is of aluminum-steel construction. Even nuts and bolts throughout machine are non-corrosive. A wide feedboard provides adequate working space. It is made of aluminum which eliminates warpage. The Hammerloid finish protects outside surfaces from scratching and abrasion. Is painted attractive gray, while all operating controls are of colored red plastic.

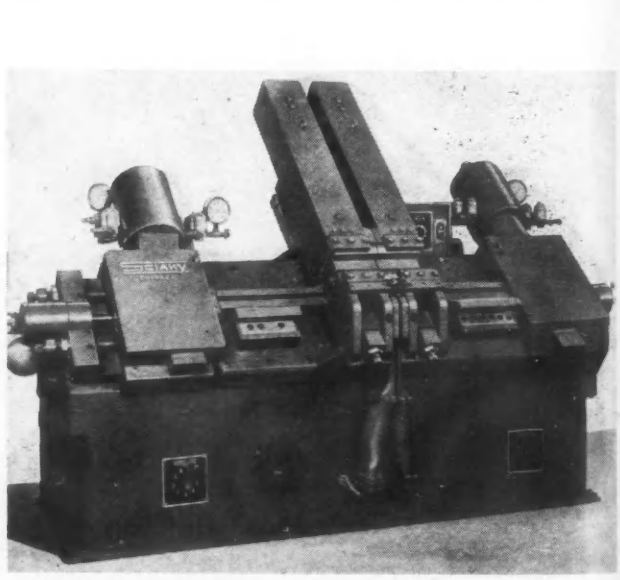
A NEW fork-type power industrial truck, identified as Model F 24 T, with an elevating reach of 18 ft above floor level has been brought out by Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland, O.

The new truck picks up loads on its bare fork or on pallets in the same manner as with standard models. Its capacity is rated at 4000 lb for lifting to a height of 11 ft, and 3000 lb to 18 ft. It is electrically driven, with three separate motors; one for traveling, one for operating the elevating mechanism, and the third for tilting the upright columns. Tilting limit is 15 deg backward and 5 deg forward from vertical.

Lifting speed with capacity load is 13 fpm, lowering speed 20 fpm; truck's traveling speed 5 mph.

Body of the truck, independent of the uprights and fork, is 7 ft 8 in. long Overall width is 3 ft, 2 in., enabling it to maneuver in narrow aisles. It is end-controlled, and the top of the body

(*Turn to page 72, please*)



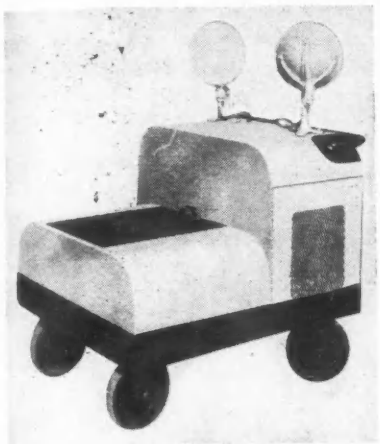
Sciaky flash welding machine

NEW Products for AIRCRAFT

Portable Auxiliary Electrical Power Unit

A portable auxiliary electrical power unit which provides heavy current starting power for all types of engines has been developed by the Airquipment Co., Burbank, Calif.

The unit can also be utilized as a



Portable auxiliary electrical power unit made by Airquipment Co.

source of standby power for energizing lighting circuits and electrical system components for long duration as long as output does not exceed the output capacity of the generator. Two adjustable 250-volt floodlights are provided for night emergencies. Power is switched from 24 to 30 volts by a single pole, double knife throw switch.

The 70-amp generating plant, five six-volt, 200-amp hr batteries, and a "plug-in" cable and hydrometer, are housed in a sheet iron cabinet. Three doors in the generator cabinet and hood over batteries provide access to all vital parts.

Small Range Receiver Announced by Bendix Radio

An unusually small range receiver has just been announced by the Bendix Radio Division of the Bendix Aviation Corp. Known as the Bendix Radio Type PAR-3 range receiver, it is suited to the smaller types of personal aircraft that are not equipped with storage batteries.

This receiver can be either mounted in the instrument panel through a standard A-N hole with dry batteries remotely located or, with a couple turns of tape, it can be attached to the battery box, providing a small portable unit that requires only an antenna connection which is provided through the bottom of the case. It can be used for airport traffic control, student control, cross-country radio range navigation, and weather reports.

The new Bendix Radio range receiver is a 3 11/16-in. cube, weighing approximately 1½ lb. The twisted cable lead, five ft in length, is provided with standard battery connectors. A stiff, impregnated, fibre-board box is furnished in which standard 67½ volt (8.5 ma) "B" and 1½ volt (0.25 ma) "A" batteries may be mounted in the aircraft.

The tuning range of this receiver is 195 to 410 kc. The circuit is a four-tube superhetrodyne, using an intermediate frequency of 455 kc. The sensitivity is 8 mv for a 4:1 signal to noise ratio. Selectivity is 25 kc total band width for 40 db attenuation. Maximum audio output is 125 mw, using 67½ volt "B" battery supply.

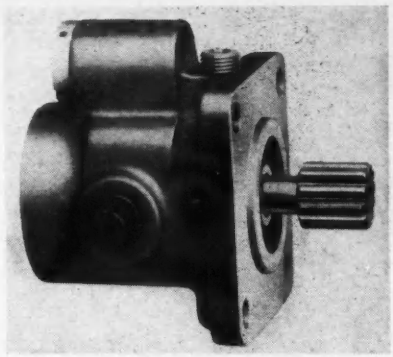
Automatic Radio Compass

The Lear Model ARC-10 automatic radio compass, manufactured by Lear, Inc., Grand Rapids, Mich., weighs only 24 lb. It is available either as a single or a dual instrument, the latter consisting of two independent ARC-10 systems with both loops housed within a single streamlined "blister" and using a single dual-pointer azimuth indicator. The dual instrument weighs only 47 lb.

The tuner unit of the ARC-10 contains all r-f circuits, and is so small —2⅞ in. high by 6⅜ in. wide—that it can be readily mounted on the instrument board. All operating controls are grouped on the tuner unit. The function selector switch enables the pilot to obtain his radio bearings automatically

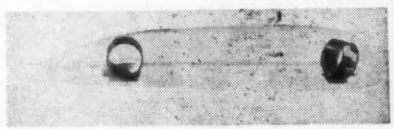
Bendix Radio PAR-3 range receivers

Non-Pulsating Fuel Pump

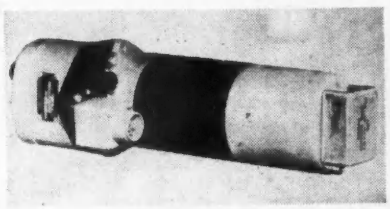


The Romec Pump Co., 139 Abbe Rd., Elyria, Ohio, has brought out this new vane-type, non-pulsating fuel pump for light aircraft. It weighs only 14 oz, and is available with various drive couplings and mounting flanges for engines and electric motors. The pump has a capacity of 75 gph, a speed range to 4000 rpm, and operates at pressures up to 60 psi.

(simultaneously with aural reception), or to use the instrument for aural-null direction finding, or for aural non-directional reception. The frequency range of the instrument is from 200 to 1750 kc, in three contiguous bands:



Dual blister of the Lear ARC-10 automatic radio compass



Servo unit of Lear automatic radio compass

200-420, 420-860 and 860-1750 kc. The 4:1 vernier tuning control knob and a tuning meter assure ease and accuracy of tuning. The illuminated dial has a dimmer control. Only the frequency band in use is visible. A beat frequency oscillator permits reception and aural-null direction finding of both voice and code signals.

The a-f circuits are housed in a remotely controlled amplifier unit.

The small loop, 4 in. in diameter, automatically turns to "face" the direction of the transmitting station.

The Lear servo unit is comprised of the dynamotor with its associated filter, and the special Lear friction drive

(*Turn to page 70, please*)

Airbriefs

by Robert McLarren

Heat Resistant Metal

The search for heat resistant metals through the experimental route, which has proved comparatively fruitless to date, has now turned back to the research laboratory. Rather than a continuation of the analysis of hundreds of alloys of nickel-cobalt-chromium, research is now being directed towards a re-examination of familiar materials through the creation of accurate equilibrium diagrams. These should provide indices to the processes which take place in the microstructure of metals at elevated temperatures. A clearer insight into the mechanism of precipitation during the hardening process must be obtained. It now appears that the rate of precipitation and of coalescence govern the stress rupture and creep strength of a metal and if these rates are too high it is possible that all beneficial effects are lost. Research now in progress on this problem is designed to produce materials useful at temperatures up to 1800 deg F. Experimental programs still show promise, however, in the intermetallic compounds with chromium borides displaying very high melting points and corrosion resistance at elevated temperatures. It is now certain, of course, that heat resistant materials in the 2000 deg. F. region and upward can contain no iron or steel alloys.

Atomic Energy

Don't look for an atomic energy powered airplane in the next decade! This is the advice of Dr. Luis W. Alvarez, famed nuclear physicist and Collier Trophy Winner. He makes this gloomy prediction not because the idea is not technically feasible but because "it would be doing an easy thing the hard way." For the man-carrying plane, the weight of shielding required would demand an airplane three or four times as big as the Consolidated Vultee XB-36. Most often mentioned application of atomic energy to aircraft, however, is in the pilotless guided missile, which would not require shielding for passengers. Dr. Alvarez discourages this idea, too, however, by pointing out that shielding would be required to protect the electronic guidance and control equipment. More to the point, however, is his criticism of those who suggest the use of recoil from atomic fission by releasing the products from a rocket nozzle. He points out that in an atomic pile only a small fraction of "fission fragments" escape from the pile, the remainder being stopped in the uranium, generating intense heat. Thus, the rocket would be vaporized by heat long before it ever reached the velocity easily attained by the V-2. Summing up, Dr. Alvarez believes that if we ever hear of an atomic energy rocket flight to the moon it will be not because atomic energy proved advantageous but because known chemical propellants proved impossible for the job.

Square Tipped Props

Following extensive tests by the AAF on a Douglas A-26 *Invader*, the Glenn L. Martin Co. has specified square tipped propellers for the new Martin 2-0-2 transport plane. These new blades, in addition to square tips, are of rectangular planform with a constant chord from hub to tip. The use of the square tip has eliminated the severe blade twist used when conventional elliptical tips were employed. This is a result of the interrelationship between airfoil chord and angle-of-attack, both providing lift and one being unnecessary to the degree that the other is present. Another advantage of the new propeller is the possibility of using a thinner, less cambered airfoil section. The air is speeded up over an airfoil in proportion to its camber and less camber creates less induced velocity, thereby delaying the onset of compressibility, with its accompanying drag increase.

Water Injection

Water injection in aircraft engines, used widely and effectively on combat planes during the war, is now being specified on the new highspeed transport planes due for scheduled airline service beginning this spring. Roughly speaking, water injection is a substitute for high octane rating fuels, i.e., 100 octane aviation fuel plus water injection provided the same knock limitations that 130 octane fuel or special blends provide. Water injection proved most useful on highly supercharged engines during the war. The new commercial transport planes, however, are not highly supercharged and will develop adequate power on conventional 100 octane fuel. The only maximum power operation of the airliner is during take off and existing runways should prove more than adequate for safe takeoffs without the use of emergency power. Water injection equipment runs around 100 lbs per engine and most airline engineers are convinced that this weight expenditure is not justified. It is of interest to note, too, that the enthusiastically hailed benefits of water injection in the compressor of turbojet engines for thrust augmentation provides little or no improvement in the takeoff run of fighter craft, in contrast to widely published statements to the contrary. Although it is true that water injection provides a considerable increase in thrust in the turbojet fighter at high speed, the horsepower of the jet engine is a function of the plane's forward speed and the difference between the jet velocity and the aircraft velocity. Since the takeoff is accomplished at speeds ranging from zero to about 80 miles per hour, it is clear that water injection provides little advantage for the purpose. At high speeds, however, thrust increase of as much as 50 per cent have been obtained.

Foreign Matter in Jet Engines

It is a well known fact that the ground running of turbojet engines has presented difficulties to the services over the past two years through the entrance of dust, dirt, oil, etc. The exact nature of the effects of such foreign matter is now available in a report on the subject revealing experience with the British Armstrong-Siddeley ASX-6 axial-flow turbojet engine. Major problem is the fact that the hot turbine bakes this matter onto the blades, thereby altering the airfoil characteristics. As a result power losses occur which vary almost linearly with the ground running time. Experience with the ASX-6 reveals that about 6 per cent static thrust is lost each 10 hours running time, or nearly 25 per cent of the total thrust after 40 hours running time. The obvious solution is screened intakes but these constitute severe icing hazards. In a paper read before the SAE annual meeting in Detroit, F. W. Disch and A. Dolinsky, Boeing Aircraft Co. engineers, suggest the use of inertia separators in the intake which create a high rotational speed to the incoming air, thereby throwing moisture to the walls of the separator. An intake screen can then be safely installed aft of the separator with little danger of icing.

NEW Products

Wilson Introduces Line of Automatic Electrodes

The Wilson Welder and Metals Co., Inc., 60 E. 42 St., New York, N. Y., has entered the field of automatic arc welding by adding Una automatic wires and Una tapes to its line of manual electrodes. Five knurled-type wires and five flux-impregnated tapes comprise the present line. Designed for flat position operation, their applications on the assembly line are many and varied, ranging from thin gauge sheet metal forms to axle housings, boilers and torque tubes.

Una automatic wires and tapes are now available in several diameters and alloy analyses. Depending upon the application, the automatic wires may be used separately or in conjunction with the tapes.

Two New Oil Filters Brought Out by Meier, Inc.

Two new types of oil filters and a new filtering medium have been announced by Meier, Inc., Maccabees Bldg., Detroit.

The company is featuring the "Meier-Matic," series 800, throw-away type filter which embodies new features of design and an "instant change" filter unit. This filter differs from the conventional in that the base bracket, center oil inlet tube and connecting oil lines remain a permanent part of the base bracket while only the metal case with sealed-in cartridge requires replacement. This metal case is held in place by a retaining band fastened by two screws which only require loosening to tilt back the holder for replacement of the filter unit.

A rigid block type, fibrous composition filter element is employed. The fibre materials are molded and baked to uniform density and hardness. This is engineered to ensure controlled fluid velocity throughout the filtering element with resultant elimination of any possible channeling of unfiltered oil.

The company is also producing a conventional type filter case with the Meier-Matic filter element. Like the series 800 filter, the conventional model employs a center inlet oil tube with connecting oil lines at the base of the filter. In addition, replacement elements are being produced in several sizes to fit all standard makes of filters.

Trico Wiper Blades for Curved Glass Windshields

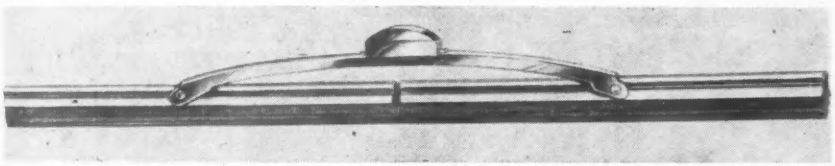
On the heels of discussion of curved glass for passenger cars and commercial vehicles, Trico Products Corp., Buffalo 3, N. Y., has announced its new line of wiper blades for simple curved glass for windshields and rear windows. A feature of the molded rubber wiping blade is that it carries an internal resilient leaf-spring member, concealed within the rubber channel, for even distribution of contact pressures.

The new blade consists of this one-piece molded rubber wiping edge, a split two-piece channel, and a specially designed Trico yoke-type connector. Function of the connector is to distribute arm pressure evenly over the entire wiping surface. Standard model curved glass blades use the same hook-on connector as do the present Trico universal and standard equipment blades for flat glass. The new product is said to prevent blocking by snow or ice.

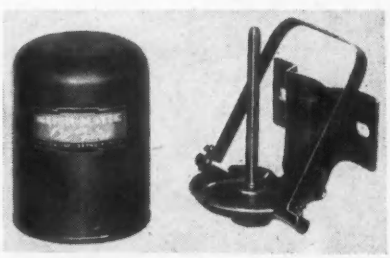
In addition to the standard model for curved glass, Trico offers another model with a distinctive wrist action connector for the wiper arm.

A more rugged heavy duty model, available for commercial vehicle service, has the same design features as do the motor car wipers.

Looking to the future, when cars will be equipped with more complex curved glass for windshields and rear windows, Trico has developed an advanced type of wiper blade. This has a curved molded rubber wiping edge with a supporting flexible back so constructed as to permit the blade to follow the contour of the glass in movement in and out of various degrees of curvature. These blades feature a special type of connector designed to hold the square cut wiping edge of the blade in correct angular relation to the glass.



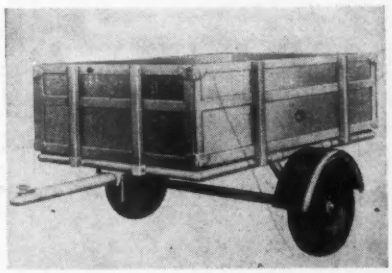
Trico curved glass wiper blade with wrist action connector



Meier-matic instant change filter

Natco Two-Wheel Trailer

The Welded Products Division of National Automatic Tool Co., Inc., 722 S. N St., Richmond, Ind., has brought out a new Natco two-wheel trailer. The chassis and racks of the new trailer are built entirely of welded tubing and solid panels. The wheels are equipped with Timken roller bearings and 6.00 x 9 tires. Rated capacity is ½ ton, capable of overload.



Natco trailer

Racks 15 in. high are regularly furnished. Extension racks, fitting into telescopic sockets, may be had to raise the sides and ends to 46 in. Another variation is a canvas canopy stretched over bows which mount on the regular bed.

The platform has 4 by 5-ft inside clearance. It is higher than the fenders to allow wide loads to be carried. Removal of a pin permits the platform to tilt for loading and dumping.

Bowser Offers Filters in Ten Sizes

Ten sizes in three new models of expendable cartridge filters are in production at Bowser, Inc., Fort Wayne 5, Ind. The filter contains new, replaceable, resin-impregnated, cellulose

Bowser filter

elements which remove particles as small as 1 micron from liquids with viscosities up to 600 S.S.U. and temperatures as high as 350F. The cellulose cartridges are completely neutral, contain no chemical bleach and will not remove additives or inhibitors, or affect the color of the filtered liquid except by the reduction or removal of foreign matter.

Based on a viscosity of 50-60 S.S.U. oil, the capacities range from 2/5 gal to 300 gal per hr with filtering areas from .2 sq ft to 100 sq ft. Pipe connections are located at opposite sides of the filter shells for "in line" piping to eliminate bends and elbows. All units are equipped with vent and drain valves and bolted covers for cleaning and convenience in replacing the expendable cartridges.

The larger models are available in four sizes; 8, 25, 50 and 100 sq-ft filtering areas. They are used in airport, railway, Diesel and bulk plant installations for Diesel fuel, lube oil, gasoline and other petroleum products.

The smallest model is available in six sizes; 1, 1½, 2, 3, 5 and 10 sq-ft filtering areas and is recommended by the maker for fuel filtration in stationary engines and wherever petroleum products are filtered intermittently or continuously in moderate quantities.

Simplified Line of Rust Preventives

E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa., has simplified its line of rust preventives and is making a series of nine products to meet all manufacturing, shipping and storage problems.

Of these corrosion preventives, four are of the removable thin-film solvent type, one is a non-removable dielectric variety and four are oil-type films varying in viscosity from thin oil film to a medium grease consistency. These rust preventives are termed "The Winning 9 from the Houghton Line." They are branded under the Cosmoline series.

The series of nine products comprising the new line-up include varieties for temporary intra-plant protection as well as for shed and outdoor exposure.

The Tocco Heat Gun

In a descriptive article concerning the new Tocco heat gun announced by the Tocco Division of the Ohio Crankshaft Co., which appeared in the Dec. 15, 1946, issue of AUTOMOTIVE AND AVIATION INDUSTRIES, an unfortunate typographical error resulted in a misstatement of the company's well-known name. The gun described is used for induction soldering, brazing, hardening, annealing, and heating for forging or forming operations, not for induction welding as was stated.

Leeds & Northrup Temperature Controller

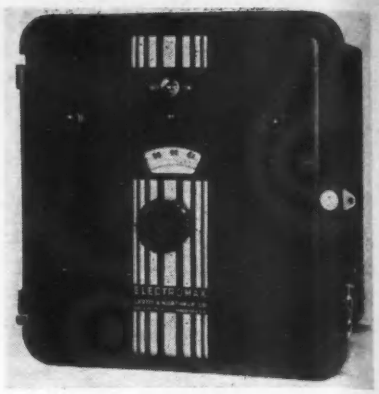
Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa., offers an inexpensive temperature controller, known as Electromax, for control of ovens, stills, baths, presses, and coolants. Especially designed for those applications where indicating and recording are not required, Electromax signals and controls only, although temperature readings can be taken manually with it at any time.

The instrument consists of a Wheatstone bridge circuit with a vacuum-tube amplifier as the detector. Vacuum tubes are standard types, require no matching, balancing or other special selection. It's completely a-c operated —needs no dry batteries or standard cells.

Temperature-sensitive elements used

New Tire for Heavy Duty Commercial Trucks

This new tire for heavy duty commercial trucks using rayon cord throughout, is a recent development of the B. F. Goodrich Co., Akron, Ohio. The tire is manufactured in sizes ranging from 6.00-16 thru 7.50-16, with which practically all the light trucks in this classification are equipped. One of the principal features of the tire's construction is its wider, flatter tread which puts more tractive rubber on the road and spreads wear more evenly.



Electromax temperature controller

with Electromax are Thermohms, Leeds & Northrup resistance thermometer bulbs. The length of leadwires does not affect calibration, and the location of Thermohms can be changed whenever desired.

The instrument case is 11 9/16 in. by 11 1/16 in. by 9 1/16 in. and can be mounted wherever convenient. Standard ranges are 0 to 250 F and 0 to 1000F or the corresponding ranges of 0 to 150C and 0 to 550C.

New Metal Joining Compound

A new plastic joining compound developed by Rolls-Royce, Ltd., Great Britain, and marketed under the trade name of Wellseal, is said to provide an effective seal against oil and gas in joining engine faces and metal joints. The compound has been applied to joints of Merlin and Griffon engines in laboratory tests and found to be highly satisfactory. It is supplied in a solution of the actual joining medium and volatile solvents which evaporate when the solution is applied to the joint face, leaving a film of the joining medium.

Mechanical Pressure Gage

W. C. Dillon & Co., Inc., 5410 W. Harrison St., Chicago 44, Ill., is making a small, compact, mechanical pressure gage that can be used to check pressure between spot welding machine electrodes, pressure between platens in all types of presses, pressure between moving rollers, tension in a moving thread, twine, wire, etc.

This new pressure gauge is compact in size—the 0-100-lb model measures 3⅝ in. long by 2 7/32 in. high by 1¾ in. wide. It weighs 1¼ lb. The 0-250, 0-500, 0-1000-lb models all measure 4 5/16 in. long by 2 7/16 in. high by 2 5/16 in. wide. They weigh 2 lb. The 0-2500 and 0-5000-lb models measure 4⅝ in. long by 2⅜ in. high by 2¾ in. wide. They weigh 2½ lb.

VIEW OF FORMER GOVERNMENT OWNED BLAST FURNACE PLANT BOUGHT BY INLAND
This plant was originally built and operated by Inland for the government to produce additional iron for war purposes. It covers 50 acres adjoining Inland's Indiana Harbor Works, and includes two 1,000 ton blast furnaces, two batteries of coke ovens, and a by-product plant.

The purchasing agreement provides that Inland shall produce merchant pig iron for the veterans' housing program for a period of time. Later on, however, it will form the basis for an increase in Inland's overall steel capacity.

INLAND STEEL COMPANY, CHICAGO, ILLINOIS

NEWS *of the* Industry

Production in 1947 Should Reach Between 3.5 and 4 Million Cars . . . Advanced Styling Seen for 1948 Chevrolets, Pontiacs and Oldsmobiles . . . Direct Relationship Exists Between Worker Productivity and Scrap Losses . . . Absenteeism at Abnormally High Rate in Most Factories . . . Parts Production Depends upon Supply of Raw Materials.

1946 has been written off by the automotive industry as pretty much of a dismal failure, but prospects for this year are considerably brighter. The general consensus among manufacturers in Detroit is that production in 1947 should reach between 3.5 and 4 million cars and about 1.2 million trucks, barring any prolonged strikes. The forecast appears to be entirely reasonable in the light of production in the closing months of 1946, when output of cars was at the rate of about 3.2 million. If four million passenger cars are built this year it will be the largest production since 1929, when 4,587,000 were built. Truck production now is at the highest rate in history and should easily reach the forecast of 1.2 million. According to best predictions available from industry leaders, the gain in the production rate of both cars and trucks will be only moderate for the first quarter of 1947, at least, and it will not be until new steel rolling facilities come in about mid-year that full volume production will be attained. The effect of the coal strike in November will be a deterrent for a few weeks, since the curtailment of steel production aggravated an already critical supply situation in that metal. Castings are another item that currently is giving some trouble. Ford operations closed from Dec. 24 to Jan. 2 because of shortages in these two categories. Hudson also was down for a week late in December for lack of steel.

Scrapping of G.M. Dies Indicates Styling Change

When General Motors announced a few weeks ago that all die work on Chevrolet, Pontiac, and Oldsmobile lines for 1948 had been stopped, observers pointed out that if the work was only suspended it could be taken up again at any time without much delay if that action seemed desirable. Since that time, however, word has leaked out that the dies have been sold for scrap. It now appears that the original thinking about styling may have been revised suddenly and the whole program thrown out in favor of more advanced designs. While this work had been in progress for some time and represented a considerable investment, the loss is probably not so great as the saving involved in using the present dies through this year. Probably a factor involved in the decision, so far as Chevrolet is concerned at least, is the number of backlog orders now on the books. T. H. Keating, Chevrolet sales manager, reports that his division's unfilled orders have risen steadily at the rate of 10,000 a month since last April, until they now total more than a million. He said that at the present rate of production the backlog will carry Chevrolet through 12½ months on passenger cars and 15½ months on trucks.

Attitude of Labor Reflected In Scrap Loss Percentage

A spokesman for an automotive company makes an interesting comment on scrap loss as a measure of labor productivity. From his company's experience, he says, there is a direct relationship between worker productivity and the amount of rejects of finished products. In one plant, for example, where the attitude of labor is very bad, about 1500 pieces out of a run of 4000 were rejected on inspection. The result was that output of satisfactory pieces produced per man was reduced a third. He added that the loss to the company was greater than it would have been had the men turned out 1500 fewer parts, all of them satisfactory, since the cost of material and handling on the 1500 rejects was lost.

Absenteeism Continues High In Most Automotive Plants

One puzzling feature of the present labor situation is the continuing abnormally high rate of absenteeism in automotive plants. Union leaders continually are pointing out the plight of the automobile workers, saying that take-home pay is entirely out of line with high living costs, but ignore the fact that weekly earnings would be larger if the workers would stay on the job and put in a full week. Apparently the rank and file worker is not nearly so concerned about his earnings as are his union leaders. If automobile workers were actually skirting the thin edge of poverty, as charged by one UAW official, it would seem that they would be impelled to put in all possible working hours to bolster their income. A drastic example of how little compulsion to work is felt by some employes is that the Briggs plant in Detroit, where only 69 per cent reported for work the day after Christmas. Other plants reported unusually high absenteeism the same day. When workers stay away from the job they are not the only ones to lose. One company reports that much of its trouble with inferior workmanship and scrapped pieces stems from the need to substitute men inexperienced on a certain operation for the regular operator who is absent. While replacement always is necessary to some degree, the unusually high rate of absenteeism compounds the problem and results in more than the normal number of persons working on jobs with which they are not familiar. A case in point was that of an engine plant which had a day's production rejected because of a bearing seal. Investigation revealed that a substitute for an absentee was not familiar with procedure.

Supply of Raw Materials To Govern Parts Production

With the automobile manufacturers planning to consume much greater quantites of raw materials this year than last, there is a question of whether there will still be enough to meet the heavy replacement parts demand. Automotive and Aviation Parts Manufacturers, Inc., has estimated the raw material requirements of both original equipment and replacement parts users on the basis of 1941 consumption. According to its findings, the parts industry used in 1946 about 19 per cent more raw materials for original and replacement parts combined than were used in 1941. If 5 million cars and trucks are built in 1947, and replacement parts requirements are met, 18 per cent more raw materials will be used than in 1946 and 40 per cent more than in 1941. If, however, no more raw materials are available this year than in 1946 and 5 million new vehicles are built, only 70 per cent of the estimated replacement requirements could be met. If new vehicle output is only 4 million, however, 87 per cent of the

(*Turn to page* 67, *please*)

BETTER SURE THAN SORRY

According to olden legend Icarus flew too near the sun, only to spin in when his wings failed to stand the stress at high temperature. Here was an early case of serious trouble due to misplaced confidence in materials.

There are many applications for steel nowadays where creep strength (the ability of steel to keep working when the heat is on) makes a tremendous difference. Molybdenum steels, being noted for their creep strength, are economical preventives of high temperature trouble.

Icarus had no accurate data on materials to guide him. A wealth of tested, practical facts about Molybdenum steels for elevated temperature service is available on request for today's engineers and designers.

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PERSONALS

Recent Personnel Changes and Appointments at the Plants of Automotive and Aviation Manufacturers and Their Suppliers.

General Motors Corp., Pontiac Motor Div.—**L. W. Ward**, General Salesmanager, succeeding D. W. Bathrick; **Ben H. Anibal**, Administrative Assistant to the General Manager; **George A. Delaney**, Chief Engineer, succeeding Mr. Anibal.

General Motors Corp.—**Paul H. Rutherford**, Special Assistant to Vice President and Group Executive in Charge of Overseas, Canadian, Dayton and Household Appliance Group.

Willys-Overland Motors, Inc.—**Walter D. Appel**, Chief Engineer; **Commodore Robert W. Cary, USN** (ret.), Director of the Planning Group, office of the President; **George M. Davies**, General Manager of Willys of Canada.

Ohio Crankshaft Co., Crankshaft and Camshaft Divs.—**Maurice J. Hoke**, Chief Engineer.

Lincoln Electric Co.—**W. R. Persons**, Sales Manager.

Republic Aviation Corp.—**Alfred Marchev**, Chairman of the Board; **Mundy I. Peale**, President, succeeding Alfred Marchev; **Alexander Kartveli**, elected to the company's Board of Directors.

Bobbi Motor Car Corp.—**George D. Keller**, President; **Robert T. Haney**, Director and Vice President in Charge of Sales.

Hudson Motor Car Co.—**Norman K. VanDorzee**, Sales Manager in Charge of Domestic Sales; **Louis A. Wehde**, District Manager for the company in Milwaukee, Wis.

Ford Motor Co.—**Thomas L. Hibbard**, Director of Styling; **George O. Simmons**, Assistant Manager of the company's Houston, Texas, sales district.

Ford Motor Co., Lincoln-Mercury Div.—**R. F. Williams**, Assistant Regional Manager in charge of the midwest region with headquarters in Chicago.

Autocar Co.—**Adolf Gelpke**, elected a Vice President of the company.

Chrysler Corp., De Soto Div.—**E. W. Brown**, Director of Distribution, succeeding J. L. Ballard.

Consolidated Vultee Aircraft Corp.—**Kenneth F. Leaman**, Manager of the company's Field Div. at Downey, Calif., succeeding George C. Ford.

Curtiss-Wright Corp.—**Joseph F. McCarty**, Treasurer and Controller, succeeding Gladding B. Coit.

Lear, Inc. of California—**Burnham Adams**, Manager.

Mack Mfg. Corp.—**Leonard E. Matzner**, Advertising Manager; **A. C. Fetzer**, elected to the Board of Directors.

Federal-Mogul Corp., Federal-Mogul Service Div.—**George Krisov**, Assistant Manager of export operations; **Richard K. McConnell**, Purchasing Director.

Joseph T. Ryerson & Son, Inc., Bearings and Babbitt Div.—**Freeman X. Kinzie**, West Coast Representative.

Illinois Tool Works, Shakeproof Div.—**Eugene W. Fuller**, Division Manager; **B. F. Bales**, Sales Manager; **Russell H. Maude**, Detroit District Sales Manager; **John B. O'Connor**, Chief Engineer; **Walter M. Hanneman**, Chief Engineer, SEMS Licensee Div.

SKF Industries, Inc.—**William L. Aiken**, Senior Division Engineer in charge of the automotive and marine department.

United Aircraft Corp., Hamilton Standard Propellers Div.—**Nevin F. Decker**, Assistant Factory Manager.

Stewart-Warner Corp.—**Samuel Insull, Jr.**, Assistant to **James S. Knowlson**, chairman of the board and president.

National Screw & Mfg. Co.—**George R. Ingersoll**, Manager of Distributor Sales.

General Electric Co., Chemical Dept., Metallurgy Div.—**Abner B. Wellborn**, Superintendent of the Div.; **V. J. Rauer**, Supervisor of Production; **G. M. Patton**, Supervisor of Planning & Wage Rate; **R. G. Mussen**, Supervisor of Test & Inspection.

General Electric Co., Research Laboratory—**Robert W. Larson**, Administrative Assistant to the Director of the Laboratory.

Fellows Gear Shaper Co.—**Henry B. Flinn**, Assistant Publicity Manager.

Chrysler Corp.—**Harry T. Woolson**, Executive Engineer, has retired.

United States Rubber Co., Tire Division—**C. A. Ostrom**, Manager of the Sales Operating Department.

Truckstell Co.—**J. Frank Shumaker**, Central Division Manager; **George W. Morse**, Assistant Sales Manager.

Twin Coach Co.—**N. V. Autra**, of Eindhoven, Holland, appointed European Representative.

B. F. Goodrich Co.—**Clyde A. Voris**, Personnel Manager of the Industrial Products Plant in Cadillac, Mich.

Firestone Tire & Rubber Co.—**Dr. J. W. Liska**, Assistant Director of the Chemical and Physical Research Laboratories.

NLRB Holds Up Action On All Foremen's Cases

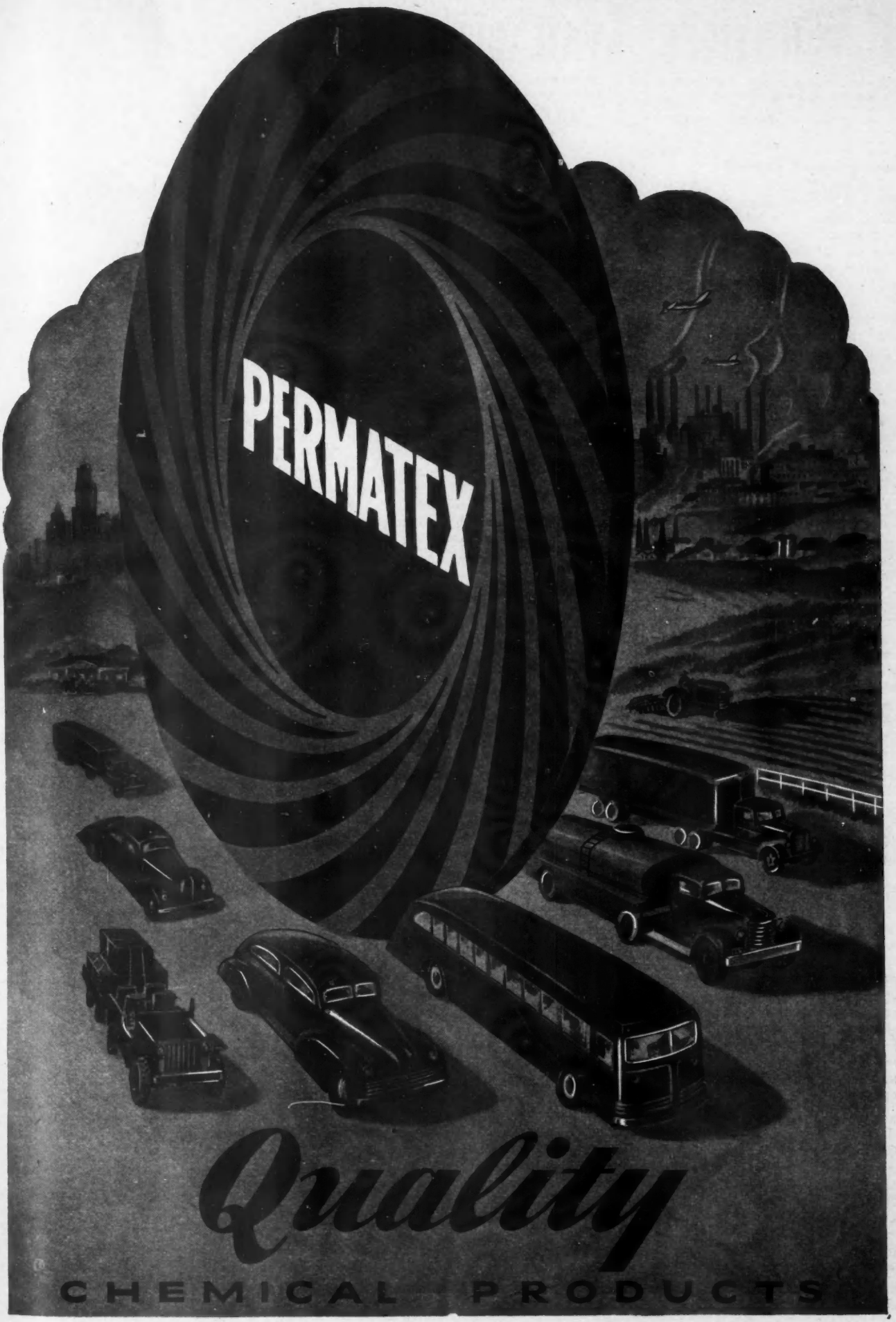
The National Labor Relations Board annqounced on Jan. 9 that it will hold up action on all foremen's cases until the Supreme Court rules on whether a firm has to bargain with a union of its foremen. The high tribunal began hearing arguments at that time on a test case involving this issue.

The NLRB issued a statement saying it decided unanimously "out of respect for the court and in view of the great public interest in the question, not to conduct any new hearings or render any further decisions in foremen's cases until the Supreme Court has spoken." The statement added: "The moratorium will be complete, except that in a few instances regional offices may be permitted to finish hearings already opened or to conduct elections heretofore directed by the board. This policy will be put into effect during the next 24 hours."

The court hearing involves the Packard Motor Car Co. and the Foremen's Association of America, an independent union of supervisory workers.

1947 Cadillac

In an effort to satisfy the greatest bank of unfilled orders in Cadillac's history, the 1947 models followed the last 1946 cars down the assembly line by less than 24 hours. The complete new line is now in production. A revised front grill is practically the only change in design.



Engineering Library

PUBLICATIONS AVAILABLE

Publications listed in this department are obtainable by subscribers through the Editorial Department of AUTOMOTIVE *and* AVIATION INDUSTRIES. In making requests give title above the item concerning the publication desired, the date of issue in which it appeared, your name and address, company connection and title.

Industrial Heat Lamps

General Electric Co., Lamp Div.—New industrial infra-red lamp illustrated folder, "Y-689". It contains descriptions, illustrations, and technical data on all the industrial heat lamps manufactured by the General Electric Co. The folder points out to the industrial user many of the uses to which the lamps are now being put. In addition, the folder enumerates six of the numerous advantages of using the infra-red lamps for industrial heating, drying and baking purposes, such as quicker heat, more comfort and safety, and more flexibility. The folder also describes the four main types of ovens used in employing infra-red lamps industrially with diagrams and pictures of each.

Hydraulic Oil Purification

Honan-Crane Corp. — A four-page folder points out to operators the way to stop down time and repairs on hydraulic presses, machine tools, plastic molding presses and machines, die casting presses, balers and injection molding machines by effective purification of hydraulic oils. The folder discusses first the common forms of contamination which cause hydraulic equipment to operate inefficiently, and reasons for the presence of such contamination in the oil. Follows an explanation of Honan-Crane oil purification and what it accomplishes in the way of removing contamination from hydraulic oils, the types of Purifiers available and typical installations with illustrations.

Caterpillar Diesel Tractor

Caterpillar Tractor Co.—Features of the "Caterpillar" Diesel D7 tractor are thoroughly covered in an attractive new 32-page catalog well illustrated by sectional and exploded views of important design features.

Spring Handbook

Accurate Spring Mfg. Co.—Third edition of the company's Handbook of Technical Data on Springs. This 36-page handbook offers data on such subjects as design formulation, load deflection, and the proper methods of specifying springs. Several helpful short cuts for making spring calculations are also presented.

Rugged Duty Light Bulbs

Lustra Corp. of America—A four-page illustrated bulletin, No. 103, describes four types of light bulbs especially designed for rugged-duty service where ordinary light bulbs fail to stand up. Vibration service lamps with all-flexible construction, rough service lamps with flexible 12-anchor filament mounts, and Milltype lamps with all-wire shock-absorbing filament supports and other rugged-duty features, are said to assure continuously efficient service in applications ordinarily destructive to standard type lamps. Traffic signal lamps are included in the bulletin and featured for commercial and industrial use in view of their extra-rugged construction for continuous "on-off" 24-hour service.

Robbins Index Table

Robbins Engineering Co.—A descriptive bulletin covering the new Robbins' index table. The Robbins' index table is described as being a fast, accurate unit for indexing on production operations such as drilling, reaming, tapping, boring, milling, etc. The complete details of the construction and operation of this unit are amplified by a large cut-away illustration on which all parts are clearly marked and defined. Specifications and dimensions of the three sizes available are also included.

Die Casting Machine

Light Metal Machinery, Inc.—A six-page folder describing the company's fully-automatic, high-speed, low cost die casting machine. Sequence illustrations of this zinc, lead and tin die casting machine show how its cycling mechanism provides automatic die movement, shot and ejection in continuously repetitive cycles.

All-Purpose Conveyor

Island Equipment Corp.—Bulletin on combination work table and conveyor. This eight-page bulletin — PF-8 — features an all-purpose conveyor, mechanized work table for assembly, inspection and packing operations—a unitized assembly or production line unitable. It is profusely illustrated, showing cross sections and parts of the equipment.

Sun Products for Industry

Sun Oil Co.—A new folder listing and describing the most important Sun products for industry. A quick and ready reference of the uses and characteristics of Sun industrial products. The folder lists cutting oils, textile processing oils, rubber processing oils, general lubricants, refrigeration oils, mine lubricants, Diesel oils, solvents, greases and waxes.

Industrial Protective Clothing

The B. F. Goodrich Co.—A 10-page booklet on the Goodrich line of industrial protective clothing tells of the new products in this field which the company has introduced in recent months, pictures each garment, described its functions in industry, and relates the method of construction and materials used.

Aircraft Shut-Off Valves

Wm. R. Whittaker Co.—A new illustrated folder recently released by the company describes its line of aircraft shut-off valves. It is illustrated with cut-away views of the motor-operated and lever-operated valves. Features such as the Whittaker fluid seal and gate rotary action are described and illustrated.

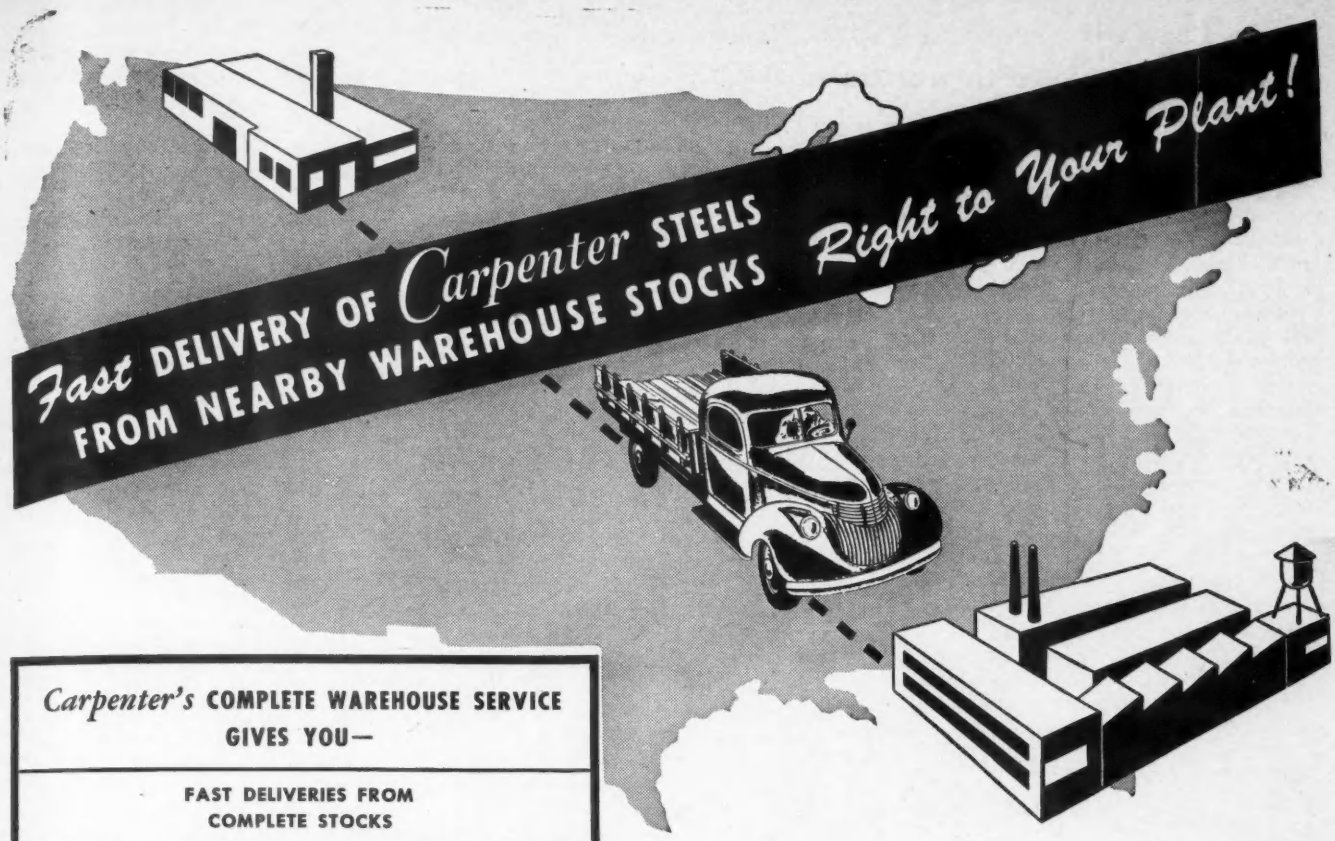
Kodak Transfax Process

Eastman Kodak Co. — A four-page booklet describes Kodak Transfax, a reproduction process for use with metals, plastics, and plywood or pressed woods. The booklet briefly explains the steps in using the light-sensitive Transfax solution for transferring working diagrams, legends, designs, or other line work from a drawing to fabricating materials. It also suggests possible uses of the Transfax process in the fields of research and production.

(*Turn to page* 68, *please*)

Weekly Production of Cars and Trucks in U. S. and Canada

Week-ending		1946	Corresponding Week in 1941
Jan.	5.....	13,920	76,935
	12.....	23,340	115,935
	19.....	28,465	124,025
	26.....	29,410	121,943
Feb.	2.....	29,295	124,400
	9.....	23,785	127,675
	16.....	21,555	127,510
	23.....	19,410	127,740
Mar.	2.....	17,575	126,550
	9.....	23,050	125,915
	16.....	35,020	131,410
	23.....	37,285	123,805
	30.....	43,070	124,165
Apr.	6.....	47,735	116,255
	13.....	49,425	99,260
	20.....	57,565	99,945
	27.....	64,620	108,165
May	4.....	67,060	130,610
	11.....	71,335	132,380
	18.....	48,565	127,255
	25.....	53,020	133,560
June	1.....	31,895	106,395
	8.....	43,175	133,645
	15.....	50,206	134,682
	22.....	54,475	133,565
	29.....	60,015	127,926
July	6.....	45,175	96,457
	13.....	74,015	114,318
	20.....	80,395	109,912
	27.....	84,720	105,635
Aug.	3.....	79,385	62,146
	10.....	77,825	41,795
	17.....	88,990	45,550
	24.....	91,360	45,525
	31.....	74,960	39,965
Sept.	7.....	72,535	32,940
	14.....	88,888	53,165
	21.....	80,972	60,615
	28.....	86,582	77,035
Oct.	5.....	91,925	76,320
	12.....	86,330	79,065
	19.....	89,540	85,600
	26.....	87,680	91,355
Nov.	2.....	95,752	92,879
	9.....	92,760	93,585
	16.....	94,425	92,990
	23.....	96,461	76,320
	30.....	77,222	93,195
Dec.	7.....	93,907	92,205
	14.....	96,887	95,990
	21.....	96,754	65,875
	28.....	67,070	24,620
Jan.	4.....	53,437	76,690
	11.....	78,329	115,935
Total.....		3,276,627	5,300,837



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More Than 60 Technical Papers Presented At SAE Annual Meeting at Detroit

During the SAE Annual Meeting in Detroit, January 6-10, more than 60 technical papers were presented at three simultaneous sessions held each morning and afternoon. Each of the sessions was crowded, the meeting rooms holding perhaps 1500 people at a time. This method of conducting the meeting broadened the scope of interest and held the attention of the major percentage of those attending.

On the basis of early estimates this meeting was considerably larger than the one held last year. Although preliminary registration figures were not large, it was estimated that attendance would go well over 6000 for the week, including the throng of almost 3000 expected for the annual banquet. Keynote talks were given by W. Averell Harriman, Secretary of Commerce, who addressed the banquet meeting, and George T. Christopher, president, Packard Motor Car Co., featured speaker for the production activity group. Secretary Harriman characterized the challenge to the present generation as being—"To develop within the framework of our free society and system of free enterprise a stable economy that gives both security and a high expanding standard of living to all our people." Government, he said, cannot and should not attempt to do the whole job of stabilizing economic activity. One way, he suggested, is for management to work toward the regularization of employment in seasonal industries. An excellent example of this, he pointed out, is the automotive industry, which, before the war, held its annual show in autumn.

Secretary Harriman urged an all-out effort for the expansion of world commerce. He said that while the present policy of the United States is to expand our markets abroad, it should be understood that this must be accompanied by an increase in imports through the proposed reciprocal tariff agreements. World trade is not a one-way street.

Speaking before a packed house, Christopher made a clear and enlightened analysis of the mutual problems of management and labor. "We now realize," he said, "that all of us in labor and management must get together and start pulling together. Our system of free enterprise is at stake. Christopher declared true industrial democracy can be achieved only through evolution, not revolution.

Believing that industrial relations must find a common middle ground, he suggested to the new congress a policy of temperance—"Be constructive. Don't destroy the good in pro-labor legislation of the past decade or so. Eliminate only those laws or sections of laws which have prevented labor and management from pulling together." On the other hand, the speaker urged labor's acceptance of legal responsibility. "More than anything else, we need legislation giving unions legal responsibility equal to that which management received years ago. It has been demonstrated that authority without responsibility will not work."

Christopher believes emphatically in retention of collective bargaining, but sees it successful only with bi-lateral responsibility. "Collective bargaining to be fair must be done on an individual company basis. There should be no monopoly by labor, any more than there should be a monopoly by management."

Labor and management must realize that their ultimate goals are the same. "Both seek high production—both seek the lowest possible prices—both seek good wages. Management must help the worker to understand the importance of increased productive efficiency and of profits. Management must encourage the worker to become really

(*Turn to page* 68, *please*)

1946 Shipments of Complete Aircraft and Other Products of Aircraft Plants*
In Units and Their Value

PRODUCT	September	October	November	Eleven Months
Complete Aircraft				
For U. S. Military				
Number of Planes	139	168	133	1,217
Value	$22,324,211	$17,356,781	$13,438,853	$172,449,740
For other than Military				
Number of Planes	4,040	4,500	2,960	32,882
Value	$14,64?,277	$14,593,797	$15,280,869	$163,882,881
Total—Planes	4,179	4,668	3,093	34,099
Total—Value	$36,966,438	$31,950,578	$28,719,722	$336,332,629
Conversions				
Number of Planes	29	27	17	308
Value	$4,415,234	$3,170,500	$936,300	$37,930,[illegible]
Airframe Spare Parts				
For U. S. Military—Value	$2,315,237	$1,950,004	$?,449,345	$27,536,902
For other than Military—Value	$1,834,868	$1,428,619	$1,386,808	$15,742,[illegible]
Total—Parts Value	$4,150,105	$3,378,623	$3,836,153	$43,279,[illegible]
All Other Products				
Modifications—Value	$98,975	$37,134	$12,258	$5,210,[illegible]
Aircraft Products—Value	$1,211,932	$302,545	$597,770	$8,430,[illegible]
Non-aircraft Products—Value	$2,542,918	$4,102,512	$3,215,928	$24,859,[illegible]

*—Industry Division—Bureau of the Census.

Civil Aircraft Shipments Classified by Total Rated Horsepower*

	1-74 Hp	75-99 Hp	100-399 Hp	400 and Over, Hp	Total
January	1,047	†	140	40	1,227
February	939	†	265	43	1,252
March	1,479	†	490	50	2,019
April	1,675	544	44	48	2,311
May	2,093	820	88	72	3,073
June	2,147	1,042	191	49	3,429
6 Months	9,390	2,406	1,218	307	13,311
July	1,915	1,076	366	31	3,388
August	2,622	1,363	670	28	4,683
September	2,185	1,059	754	42	4,040
October	2,441	1,207	825	27	4,500
November	1,483	614	830	33	2,960
11 Months	20,026	7,725	4,663	468	32,882

*—Industry Division—Bureau of the Census.

Civil Aircraft Shipments by Number of Engines*

	1 Engine	2 and 4 Engines	Total Planes
January	1,187	40	1,227
February	1,204	48	1,252
March	1,969	50	2,019
April	2,263	48	2,311
May	3,001	72	3,073
June	3,381	48	3,429
6 Months	13,005	306	13,311
July	3,363	25	3,388
August	4,658	25	4,683
September	4,002	38	4,040
October	4,475	25	4,500
November	2,927	33	2,960
11 Months	32,430	452	32,882

*—Industry Division—Bureau of the Census.

Civil Aircraft Shipments by Number of Places*

	2 Place	3 and 4 Place	5 and More Places	Total
January	1,172	....	55†	1,227
February	1,180	....	72†	1,252
March	1,919	....	100†	2,019
April	2,219	44	48	2,311
May	2,921	80	72	3,073
June	3,202	178	49	3,429
6 Months	12,613	302	396	13,311
July	3,087	271	30	3,388
August	4,199	457	27	4,683
September	3,504	497	39	4,040
October	3,920	553	27	4,500
November	2,218	709	33	2,960
11 Months	29,531	2,799	552	32,882

*—Industry Division—Bureau of the Census.

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CALENDAR

Conventions and Meetings

Natl. Assoc. of Eng. & Boat Mfrs. Motor Boat Show, New York City, Jan. 10-18

Truck-Trailer Mfrs. Assoc. Annual Convention, Memphis, Tenn.....Jan. 13-14

Natl. Materials Handling Exposition, Cleveland .....Jan. 14-17

Veteran Motor Car Club of America Antique Auto Show, Boston.....Jan. 24-29

Institute of the Aeronautical Sciences Annual Meeting, New York City, Jan. 27-30

New York Aviation Show, Grand Central Palace, New York City.....Feb. 1-8

Amer. Soc. for Testing Materials—Spring Mtg., Phila.....Feb. 24-28

American Society of Tool Engineers Fifteenth Annual Convention, Houston, Tex. .....Mar. 19-22

Amer. Society for Metals, San Francisco .....Mar. 22-27

Midwest Power Conference, Chicago, Mar. 31-Apr. 2

Nat'l Assoc. Corrosion Engineers National Convention, Chicago...April 7-10

American Foundrymen's Association Fifty-first Convention, Detroit, Apr. 28-May 1

Amer. Society for Testing Material, Annual Mtg., Atlantic City..June 16-20

Kaiser-Frazer Proposes Taking Over Graham-Paige

Graham-Paige Motors Corp. has sent formal notices to its stockholders of a special meeting at Willlow Run, Mich., on Feb. 5, 1947, to vote on a proposed agreement with the Kaiser-Frazer Corp. whereby Kaiser-Frazer will take over Graham-Paige's automotive assets.

Approved by the Graham-Paige board of directors on Dec. 12, 1946, the agreement provides that Kaiser-Frazer will issue to Graham-Paige 750,000 shares of Kaiser-Frazer common stock and will agree to pay the interest and principal of the outstanding four per cent convertible debentures of Graham-Paige, due 1956, amounting to $8,524,-000. In exchange therefor, Graham-Paige will transfer to Kaiser-Frazer the automotive assets of Graham-Paige, plus $3 million and certain other assets (or cash in lieu thereof).

Graham-Paige will retain, through a wholly owned subsidiary, its farm implement business which includes the manufacture of the Rototiller farm machine and the marketing of attachments therefor as well as of a number of other items of farm equipment. The farm implement business is currently earning at the rate of $1,200,000 per year before federal taxes. In addition to this business, Graham-Paige will also increase its stock interest in Kaiser-Frazer from its present holdings of 250,000 shares to 1,000,000 shares, which will be 21.05 per cent of the outstanding stock of Kaiser-Frazer.

Accompanying the notices were financial and profit-and-loss statements of both Graham-Paige and Kaiser-Frazer for the 10 months ended Oct. 31, 1946. The 10 months consolidated profit-and-loss statement for Graham-Paige disclosed a loss, before provision for recovery of federal income and exces profits in 1944 and 1945, of $5,470,-311.55. The "carry back" recovery from the government, according to the statement, will be $2,587,281.98, of which $2,072,117.44 will be refunded (the difference not having been paid), making the net loss for the 10 months period $2,883,029.57.

New Passenger Car Registrations*

First 10 Months 1946 and 1941 Compared.

MAKE	October 1946	September 1946	October 1941	Ten Months 1946	Ten Months 1941	Per Cent to Total Ten Months 1946	Per Cent to Total Ten Months 1941
Ford	41,871	37,546	24,670	249,291	548,300	19.03	16.17
Chevrolet	41,516	43,292	40,243	209,421	809,392	15.99	23.87
Plymouth	24,212	25,296	21,052	172,599	415,125	13.17	12.24
Dodge	13,181	14,620	10,455	108,144	195,326	8.25	5.76
Buick	20,049	18,918	10,588	82,341	276,950	6.29	8.16
Pontiac	16,988	14,354	12,054	74,620	258,124	5.70	7.61
Nash	8,636	7,231	3,398	64,499	70,990	4.92	2.09
Oldsmobile	13,899	12,605	7,832	59,568	207,927	4.55	6.13
Hudson	7,234	8,578	4,149	56,085	66,214	4.28	1.95
Chrysler	6,277	7,230	5,912	52,642	132,006	4.02	3.89
De Soto	4,810	5,382	4,450	44,445	83,242	3.39	2.45
Mercury	8,846	7,151	3,395	43,338	73,051	3.31	2.15
Studebaker	7,353	7,912	6,194	42,688	101,568	3.26	2.99
Packard	4,579	4,399	6,082	25,726	60,256	1.96	1.78
Cadillac	3,131	3,006	2,728	15,061	53,411	1.15	1.57
Lincoln	1,437	1,242	969	7,361	16,417	.56	.48
Crosley	616	419	136	1,264	958	.10	.03
Willys	219	22	1,135	241	20,407	.02	.60
Kaiser	133	3	.....	138	.....	.01	.....
Frazer	119	4	.....	124	.....	.01	.....
All Others	74	69	43	441	2,565	.03	.08
Total	225,180	219,281	165,485	1,310,037	3,392,231	100.00	100.00

*—Data from R. L. Polk & Co.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE *and* AVIATION INDUSTRIES

Continued advances in general business activity are indicated. The *New York Times* index for the week ended December 21 stands at 145.7, as against 141.6 for the preceding week and 126.1 a year earlier.

Sales of department stores during the week ended December 28, as reported by the Federal Reserve Board, equaled 279 per cent of the 1935-39 average, as compared with 532 per cent in the week before. Sales were 76 per cent above the corresponding distribution a year earlier, as against a preceding similar excess of 26 per cent. The total in 1946 so far reported is 28 per cent greater than the comparable sum in 1945.

Electric power production increased slightly in the week ended December 28. The output was 18.2 per cent above the corresponding amount in 1945, as compared with a like advance of 11.7 per cent shown for the preceding week.

Railway freight loadings during the same period totaled 627,967 cars, 24.9 per cent less than the figure for the week before but 24.1 per cent above the corresponding number in the preceding year.

Crude oil production in the week ended December 28 averaged 4,713,200 barrels daily, 5,350 barrels more than the preceding average and 239,300 barrels above the comparable output in 1945.

Production of bituminous coal and lignite during the week ended December 28 is estimated at 9,120,000 net tons, 30.0 per cent below the output in the week before. The total production in 1946 so far reported is 9.1 per cent less than the corresponding quantity in 1945.

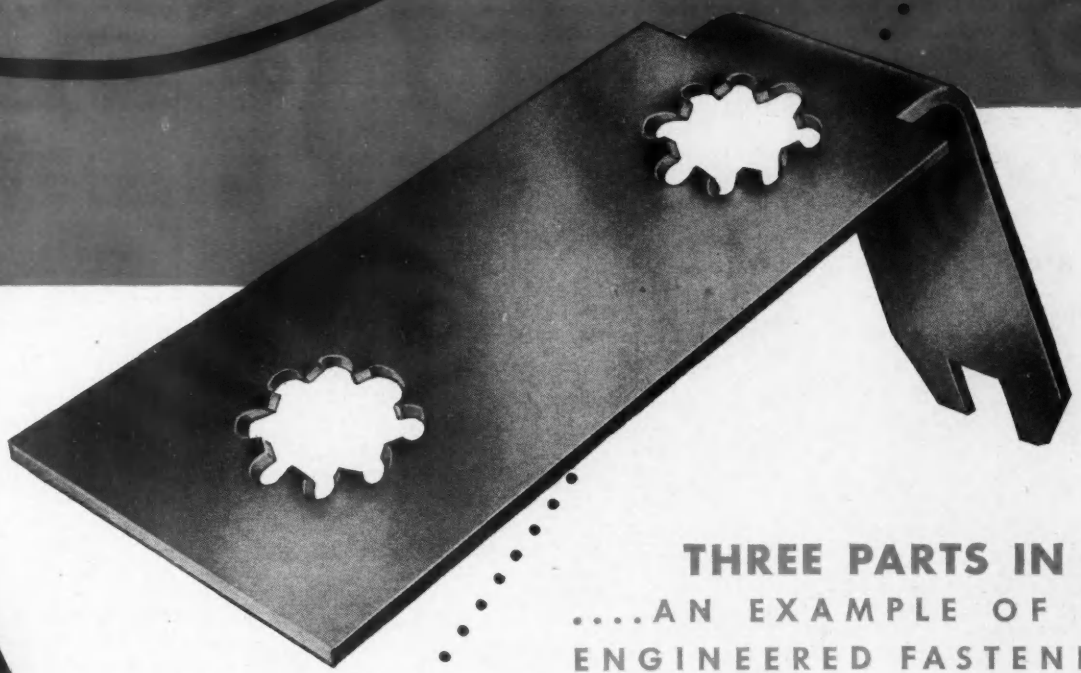
Civil engineering construction volume reported for the week ended January 2, according to *Engineering News-Record*, is $61,908,000, or 80 per cent above the preceding weekly figure and 43 per cent above the comparable sum a year ago. The reported increase in private construction over the preceding week is 27 per cent, and the rise in public construction is 227 per cent.

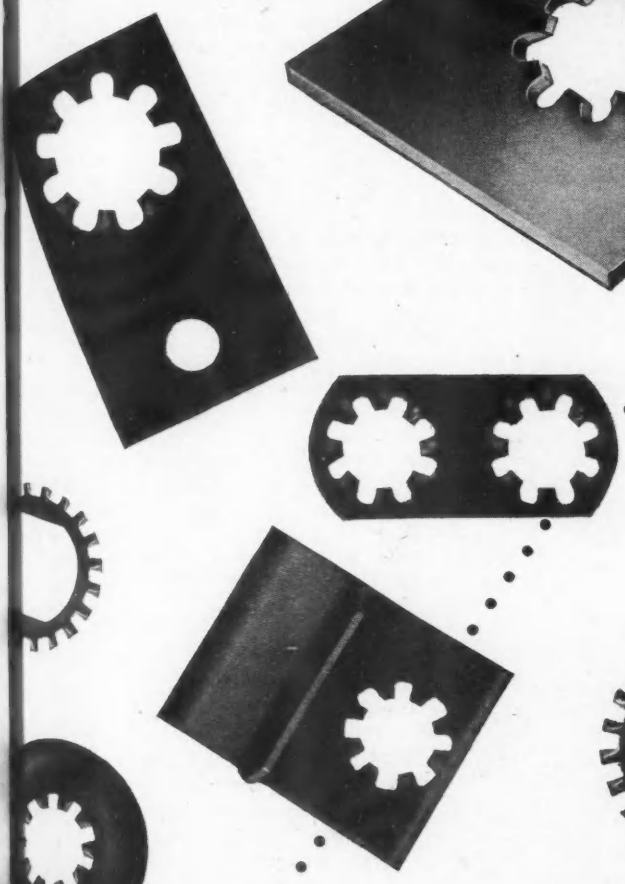
The wholesale price index of the Bureau of Labor Statistics for the week ended December 28 is 139.6 per cent of the 1926 average, as compared with 139.8 for the preceding week and 107.0 a year earlier.

Member bank reserve balances decreased $391,000,000 during the week ended December 31. Underlying changes thus reflected include a decrease of $784,000,000 in Reserve bank credit and a decline of $154,000,000 in Treasury deposits with Federal Reserve banks, accompanied by a reduction of $212,000,000 in money in circulation.

Total loans and investments of reporting member banks decreased $692,-000,000 during the week ended December 24. A decline of $17,000,000 in commercial, industrial and agricultural loans was recorded. The sum of these business loans, $10,334,000,000, shows a net increase of $3,075,000,000 in twelve months.

Here's a SHAKEPROOF Cost-Saver!



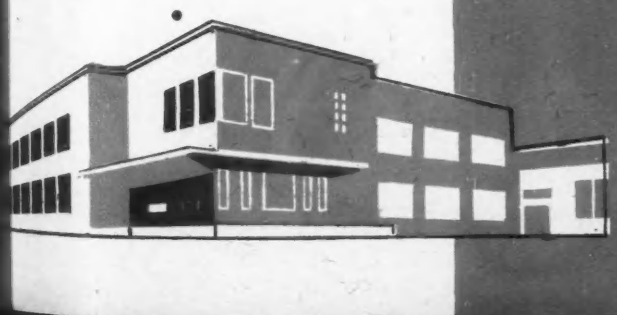


THREE PARTS IN ONE

....AN EXAMPLE OF HOW ENGINEERED FASTENINGS REDUCE COSTS!

Cost is a lot of little things. Here is one small part of an assembly that originally called for installation with two lock washers under screws. With production calling for thousands of these parts monthly, unit assembly time is important. In addition, the essential lock washer *might* be omitted by a hurried worker. But by calling Shakeproof Inc., the manufacturer obtained an *engineered part* which incorporated the locking feature so necessary . . . eliminated the use of separate lock washers . . . reduced his material cost . . . lowered assembly charges . . . increased the speed of attachment . . . and became absolutely sure of quality control.

If you are planning to use small stamped parts that must be locked tight, where high production and speed of assembly are important factors, it will pay you to investigate the advantages of Shakeproof Engineered Fastenings. Do it today!



SHAKEPROOF INC.

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2501 North Keeler Avenue, Chicago 39, Illinois

6533 South Lobree Ave., Los Angeles 36, Cal. 2895 E. Grand Blvd., Detroit 2, Mich.

Plants at Chicago and Elgin, Illinois. In Canada: Canada Illinois Tools, Ltd., Toronto, Ontario

The New American Market

*By J. R. Davis, Vice-president and Director of Sales and Advertising of the Ford Motor Company**

Statistics paint a portrait of our times which cannot be gained in any other way. In 1934, 75 per cent of new car registrations were in the low-priced field. Since 1934 the percentage has been steadily declining until today only a little more than one-half new new car registrations are in the low-priced field. We see in these percentages a trend, even in the prewar years, toward bigger and more luxurious transportation at a time when the so-called low-priced cars were themselves getting bigger and more luxurious year by year.

Then came the war years. During this period, production and hence the income of the American people, increased tremendously. In 1940 the working force of this country was approximately 55 million with nearly nine million unemployed. Early in 1945, on the other hand, the working force had grown to 65 million, and only one million were unemployed. Considering only civilians and eliminating men and women in the Armed Services, we find that in September, 1946 we had 57 million civilians employed or over 11 million more than in 1940.

Throughout the wartime period wage rates were high; whole families were sometimes employed; overtime and incentive payments were the rule; and great numbers of people found themselves in a position to spend money for quality products which had formerly been beyond their reach. Great numbers of them began to buy these quality products.

Before the war two out of three people purchased a used car rather than a new one. For example, out of 27 million motor vehicles on the American highways, 18 million of them were purchased by their owners as used cars. Recent extensive surveys now convince us that this ratio of used to new car purchasers will be substantially changed. Instead of only one out of every three buying new cars the ratio for several years at least may be more nearly one for one. This is just further evidence that when people have the means they prefer better merchandise.

One more evidence of choosey buying habits on the part of the American people is the fact that more and more products which have no established reputations behind them—no well-known and extensively advertised names—no proof of quality which resides in the prestige of the maker—are today finding it hard going. During the war and later, when the consumer's problem was not to choose among many things, but to find something in the market, new and unknown products sold readily. But today consumers are turning so positively toward the established and widely advertised products that much of the unknown manufacturer's output is being forced into the export trade.

It is a perfectly normal and proper question to ask whether this tendency is temporary. How long will it last? We all remember the silk shirt era of World War I. We know also that the manufacturer and the retailer in many fields, trying with difficulty to live under a wartime system of price controls, has frequently been driven out of the low-priced fields and forced by hard economic circumstances to manufacture and sell high-priced specialties to keep his business in the black.

If this is true, it is a profound fact for every 1947 merchandiser. Since it has been the history of the automobile business, and many other major American industries, to work continually

(*Turn to page 60, please*)

*From an address before the New England Sales Management Conference.

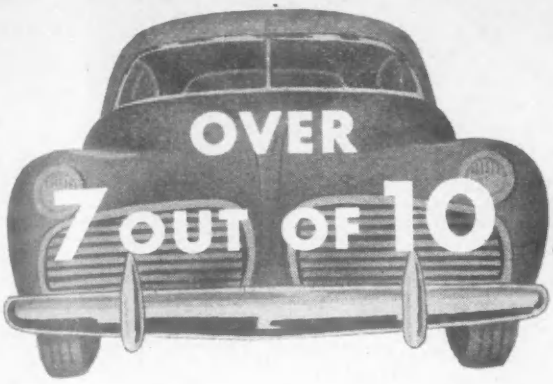
BIG BENDS... little bends... complicated bends... are all handled with ease and accuracy on R. D. Wood hydraulic bending and straightening presses. Self contained, these presses are under positive control of the operator at all times... an important feature during difficult bends. Their heavy-duty construction means longer life with a minimum of maintenance. Wood builds these presses in a full range of types and sizes for pipes, tubes and structural shapes... as well as many other types of hydraulic presses. Outline your needs so that we may send descriptive literature, or the advice of our engineers where the requirements are unusual. R. D. Wood Company, Public Ledger Bldg., Independence Square, Philadelphia 5, Penna.

Double-ended, pipe bending press—125-62½ tons capacity. Designed to handle pipes and tubes from 2½" to 14". Request catalog page W-334.

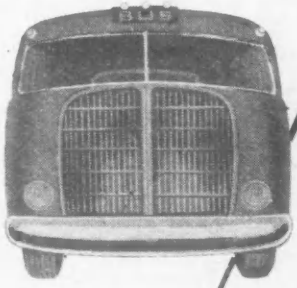
SALES REPRESENTATIVES: Dorr-Patterson Engr. Co., 3362 Wight St., Detroit, Mich. • Charles C. Grant, 436 Second Nat'l Bldg., Akron 8, O. • R. C. Neal Co., Inc., 76 Pearl St., Buffalo 2, N. Y. • R. C. Neal Co., Inc., 46 Andrews St., Rochester, N. Y. • R. C. Neal Co., Inc., 569 S. Clinton St., Syracuse, N. Y. • Neal & Co., 1009 W. 6th St., Erie, Pa. • Storey Pump & Equipment Co., Harbour Commission Bldg., Toronto 1, Ont., Canada • J. Thos. Holveck, P. O. Box 8564, Wabash Sta., Pittsburgh, Pa. • Herman L. Krouse, 4217 Buell Dr., Fort Wayne, Ind. • Mills Winfield Co., 407 S. Dearborn St., Chicago, Ill. • Harry G. Mouat, 544 Martin Bldg., Birmingham, Ala. • Fred S. Renauld & Co., 1014 W. 84th Place, Los Angeles 44, Calif. • G. M. Cooke, 401 Rialto Bldg., 116 New Montgomery St., San Francisco 5, Calif.

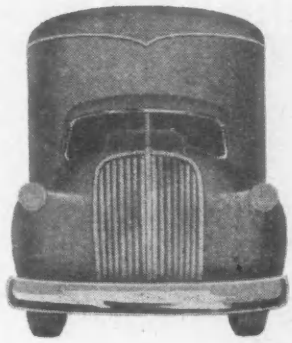
HYDRAULIC PRESSES AND VALVES FOR EVERY PURPOSE • ACCUMULATORS • ALLEVIATORS • INTENSIFIERS

R. D. Wood Company



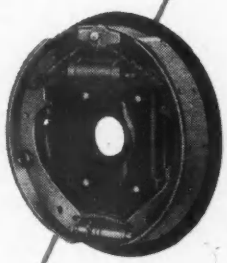
Automotive Vehicles Ever Built have been Better Because of





Bendix Experience

That Bendix is the world's largest manufacturer of automotive brakes is common knowledge in the trade. Bendix engineering experience over the years serves as concrete assurance of better things from Bendix in the future. Expect the best from Bendix —Brake Headquarters for the automotive industry.



Experience is the reservoir of precedent that holds many of the answers to problems of the future, and makes it possible to avoid errors of the past. The most promising plan can go astray in one tiny error that experience would have forestalled. And in the automotive field—where experience is the keystone of success—Bendix* can point to thirty years' cooperation with a progressive industry.

BENDIX PRODUCTS DIVISION, BENDIX AVIATION CORPORATION, SOUTH BEND 20, IND.

*REG. U. S. PAT. OFF.

PRODUCT OF Bendix AVIATION CORPORATION

WHEEL BRAKES
CENTERMOUNT PARKING BRAKE
HYDRAULIC REMOTE CONTROLS
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HYDROVAC* POWER BRAKING
B.K.* VACUUM POWER RELAY VALVES
TRAILER VACUUM POWER BRAKES
HYDRAULIC POWER STEERING

toward better products—more for the money—I believe that it is true.

Don't let me give you the impression that the American people are not interested in economy and low prices. They are. They have been. They probably always will be. But, the American people want better quality at low prices. They have acquired a habit of better things. It is not a habit they want to break. Given increased buying power during the war and since its close, they educated themselves to prefer higher quality goods and services. Today they not only take utility for granted, but they take an increasing number of yesterday's luxuries for granted.

The problem this change creates for manufacturers and merchandisers is a big one. We are being asked by our fellow citizens today to give them better products and lower prices. They want both. It is a great challenge to the ingenuity of all of us but a still greater opportunity for those of us who intend to be first in every advance.

We at the Ford Motor Company are continually exploring the possibility of manufacturing a new, low-priced car which would, necessarily, be simpler, smaller, with fewer luxurious fittings. During the past two years we have been investigating public attitude and reactions. When we suggest a small car for the sake of economy, we get answers which indicate that people don't want to sacrifice the car features they have been accustomed to, for example, riding quality and general comfort.

When we suggest a lighter car, people agree readily enough, but then they promptly tell us that they don't want a car so light that it will not have the "roadability" required by the average driver.

When we begin to ask about accessories, comments from all areas show conclusively that radios, heaters, lighters, clocks, sunvisors and ash trays are now widely regarded as necessities. Bumpers, you know, were sold not many years ago as an accessory; now they are standard equipment on all makes of cars.

So, I think the American people want, expect, and will get a kind of product in this post-war world of ours which is substantially superior to the products we considered customary and normal before the war. The "New American Market" is a different market and increasingly a higher quality market.

In 1929 our national income was approximately 83 billion dollars. In 1940 it was approximately 77 billion dollars. In 1946 it was approximately 167 billion dollars—in other words in 1946 it was greater than 1929 and 1940 combined and approximately double the legendary 1929 figure. When we examine this great increase in national income, and when we take into account the fact that more than 11 million people have been added to the employment rolls of the country, we find ourselves confronted by statistics which seem to relate to quite a different nation from the one we left behind when we entered World War II. And further exploration merely confirms our feeling that we are in new territory. At the present time, for example, approximately 24,000,000 consumer spending units (that is to say families and single individuals) have annual incomes over $2,000. That is nearly four times the six million consumer spending units which had $2,000 a year in 1935-36 and nearly double the 14 million of 1941.

Studies indicate that millions of American families have moved up into higher income brackets and find themselves with larger amounts of "free money." In 1941, for example, about 6 per cent of American families had incomes of $5,000 a year or more. In 1946 about 17 per cent of American families were in that classification.

In 1941, we estimate about 16 per cent had incomes between $3,000 and $5,000. In 1946, 28 per cent of American families were in that classification. In 1946, the percentage of families in the $2,000 to $3,000 income group had dropped from 22 per cent to 21 per

(*Turn to page 62, please*)

**7 out of 11 manufacturers rated AAAA in Thomas' Register*

Sure, those numbers show a one-sided preference for Oakite cleaning materials. But that preference also means that Oakite materials have proved their cleaning effectiveness right on the job under the toughest conditions. Helped produce quality work at low per-unit cost. That's why 7 of those 11 leading makers of radiators insist on Oakite materials for such production cleaning jobs as removing stamping and cutting paste, cleaning cores before soldering, cleaning parts before painting and enameling, rust-proofing parts between operations. They *know* they can depend on Oakite materials for the precise degree of cleanliness so necessary to the production of quality radiators.

How YOU Can Profit!

No matter what product you make, it'll pay you to investigate Oakite materials for your descaling, derusting, degreasing, decarbonizing, paintstripping and related cleaning procedures. The long list of Oakite materials includes alkaline, solvent and acidic type compounds deliberately designed to give you more cleaning work in less time for less money. If you want help to solve your production-cleaning problem, ask your nearby Oakite Technical Service Representative to stop in. He'll make recommendations sure to meet your most exacting cleaning requirements. Or, if you prefer, send for technical data on any phase of cleaning. Both service and literature—yours for the asking. Write Oakite Products, Inc., 28A Thames Street, New York 6, N. Y.

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SPECIALIZED CLEANING MATERIALS • METHODS • SERVICE

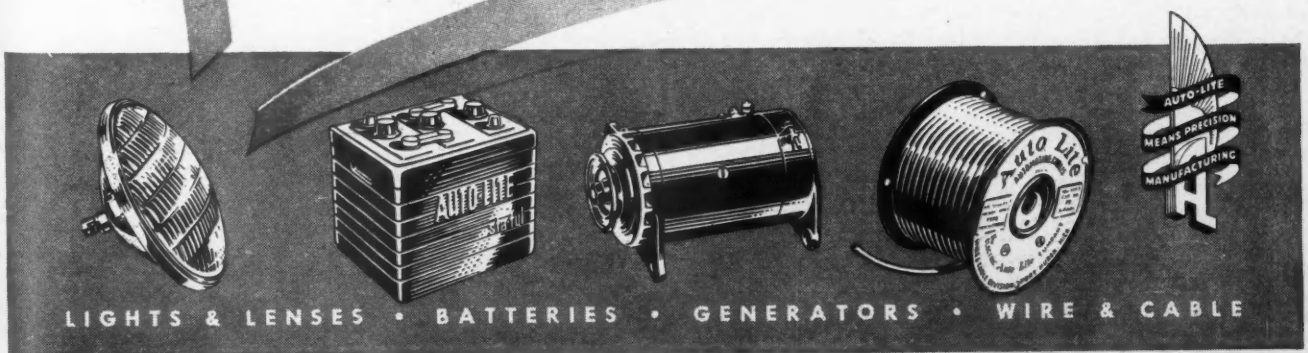
Technical Representatives in Principal Cities of U. S. & Canada

Switch to AUTO-LITE spark plugs

● It would be expected that engineers who design complete automotive electrical systems also would design America's best spark plugs . . . and that is true.
Auto-Lite Spark Plugs are ignition engineered to help assure maximum efficiency from every type of engine. Their reputation for quality and reliability has made them original factory equipment on many of America's finest cars, trucks and tractors . . . proof money cannot buy a better spark plug.

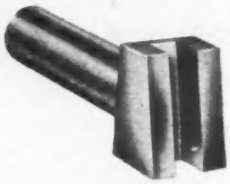
THE ELECTRIC AUTO-LITE COMPANY
Sarnia, Ontario — Toledo 1, Ohio

Money cannot buy a better spark plug



Tune in the Auto-Lite Radio Show starring Dick Haymes, Thursdays, 9:00 P.M.—E.T. on CBS.

miracles
and "Soluble" Cutting Compounds

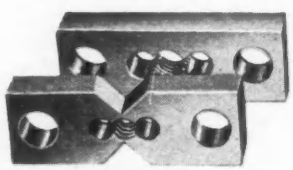


Solvol and KleenKut, Stuart's water-mixed cutting fluids, while they share in many a machining "miracle," are not "miracle" compounds. They *are* expertly engineered and manufactured products, whose performance is unsurpassed among water-mix, or "soluble" cutting fluids.

Stuart's Solvol, a "super soluble" because of its unusually high cutting quality, will handle jobs beyond the scope of conventional water-mix products, including many so-called all-purpose compounds.

Stuart's KleenKut, a more conventional product, is still an outstanding "soluble" cutting compound with a long record of superior performance.

Try Solvol or KleenKut water-mixed cutting fluids the next time you want a machining "miracle."



Have you received your copy of "Water-Mixed Cutting Fluids"?

D.A. Stuart Oil Co.
EST. 1865 LIMITED

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Stuart Oil Engineering Goes With Every Barrel

cent. The percentage in the $1,000 to $2,000 group had dropped from 27 per cent to 18 per cent, and the percentage of American families with incomes under $1,000 declined from 28 per cent in 1941 to 14 per cent in 1946.

What do these changes mean? To me they mean tremendous increases in the buying power of the American family unit. They mean a huge increase in the potential market for products, particularly those on which families spend more money as they move up in the income scale.

By the same token, there is a present domestic demand for four and one-third million new passenger cars per annum at present prices—without taking into account any deferred demand as a result of the war. That's more passenger cars than the industry has ever been called upon to produce for the domestic market. The statisticians tell us that the "New American Market" is that big without taking into account the possibility that an increased percentage of total income might be spent by each income group for the purchase of automobiles, or that people may draw on their huge liquid asset reserves. It assumes that the ratio of automobile buying per hundred families is the same in the postwar world as it was in the prewar world.

As another indication of the kind of market we are entering, consider these facts. On Jan. 1, a year ago, the backlog of unfilled orders for Ford cars and trucks stood at 868,000. During the past year Ford produced 574,000 Ford cars and trucks. By mid-December the backlog had climbed to 1,568,000—an increase of 80 per cent.

The pressure for deliveries still shows no sign of slackening, nor does price yet seem to be exerting any drag on demand. Our last price increase was on the 16th of September. In October our backlog of unfilled orders rose 77,000—a figure above the normal monthly increase. November continued to rise. By every index we know, the automobile market looks firm and urgent, both for the short-term and long-term future.

Taking into account the large wartime accumulation of deferred demand, I estimate that the automobile industry has, at the present time, an immediate market (not yet fully expressed in the form of orders) for at least 12 million motor vehicles.

This great potential market should be good news to everyone. It should mean steady jobs at good pay for many years to come. There is, unfortunately, a big toad in the water bucket. The big potential market may be very sharply reduced if we don't keep prices from going up. No matter how anxious people may be to have better things, all of us buy at a price. As prices rise, we buy more and more reluctantly. Resistance increases. Finally, a time arrives when we refuse to buy. Look what happened to the market for mink coats recently, and we all know what

(*Turn to page* 64, *please*)

Revelation of a Production Ace

Magicians manipulating cards seldom succeed with heavy, muscular hands. Traditionally, such manual dexterity is associated with adroit, supple fingers, not piano-moving strength.

In a production machine, too, the combination of strength and dexterity is rarely expected, yet Clearing has long built press equipment of exactly that combination—tremendous strength and remarkable precision. The same press that exerts the pressure of a giant will deliver parts to amazingly close tolerances.

This unique combination in the Clearing press opens up whole new vistas of operating economies. Everybody knows that a *press* delivers parts faster and at lower cost than any other available means of production. This, coupled with the Clearing ability to stamp out sizable parts with extreme precision, may give you just the winning cards you need in a battle against rising manufacturing costs. Here is a production ace whose potentialities shouldn't be overlooked.

If you can see the possibility of utilizing the speed, the precision, the strength and the low unit cost of a Clearing press at some new point in your production line, don't hesitate to consult with us. At Clearing you'll find full cooperation and expert advice in what a press can do for you.

CLEARING

THE WAY TO EFFICIENT MASS PRODUCTION

CLEARING MACHINE CORPORATION

6499 WEST 65TH STREET • CHICAGO 38, ILLINOIS

happened when the housewife refused to buy butter at a prohibitive price. So, if new car prices get too high, people will find ways and means of getting along with their old ones.

We must always remember that we live in a mass production economy. What we enjoy in the way of the good things of the earth we owe to our unrivaled capacity for quantity production. Industrial enterprises have been built on a program of tremendous output. Only when they can achieve this huge production can they break even or make a profit. Strikes and work stoppages of all kinds cut down output and seriously endanger the survival of great companies geared to exist only at high output. When suppliers are prevented from keeping the flow of raw materials constant the same thing happens. An enterprise like the Ford Motor Company, for example, is in reality a huge market place for thousands of small producers. We buy hundreds of millions of dollars of parts and materials from other American companies, many of them quite small.

At the Ford Motor Company our constant aim today is to get prices down. Our engineering, manufacturing, and purchasing departments are continually working with the hundreds of our suppliers to reduce their cost so that we can reduce ours. Our purchasing department recently instituted a plan of decentralized buying for our 13 assembly branches throughout the United States. The purpose was to eliminate long freight hauls, expedite delivery, to save time, reduce costs and at the same time to place the business in the locality of our operations.

Within this short space of time, the dollar volume placed locally by the Ford Somerville Branch, for example, has increased as much as 300 per cent in a single month's business.

Our aim in the field of distribution is the same at Ford as our aim in manufacturing and engineering. We want to make it easier for the human machine to do the best possible job. We want to conserve human energy. We want to cut down waste time, waste motions, lost selling time so that the dealer has maximum opportunity to concentrate on successful management of his business.

We have new instruments to use in achieving lower distribution costs. One of them certainly is the improved techniques of consumer preference analysis. Determining public attitudes toward products and ideas is much more nearly a science today than it was before the war. It is easier to estimate public reactions for sales and design purposes. A major responsibility of automotive research is consumer studies to determine what people want in their cars. Without such research, the Sales Manager is "flying blind." In the new postwar American market, trends must be followed closely. We can't wait for sales records to indicate public preferences. We must anticipate.

There is evidence that we are already moving out of a seller's market into a buyer's market in some lines of merchandise. The consumer is coming into his own again. That's good news. A prolonged and deep seller's market is not a good thing. It isn't healthy. The production of goods and services is soundest when we are all conscious that, in the last analysis, we are performing a public service. The seller is better off when he is most alert to the needs and wishes of the buyer. A seller's market puts a premium on laziness, carelessness and inefficiency.

This nation is economically most healthy when the consumer is boss and we are using our greatest skill and ingenuity to satisfy the demands of the American people for better things at lower prices. That's the kind of exercise that makes good salesmen and strong dealers. That way lies hard and healthy competition.

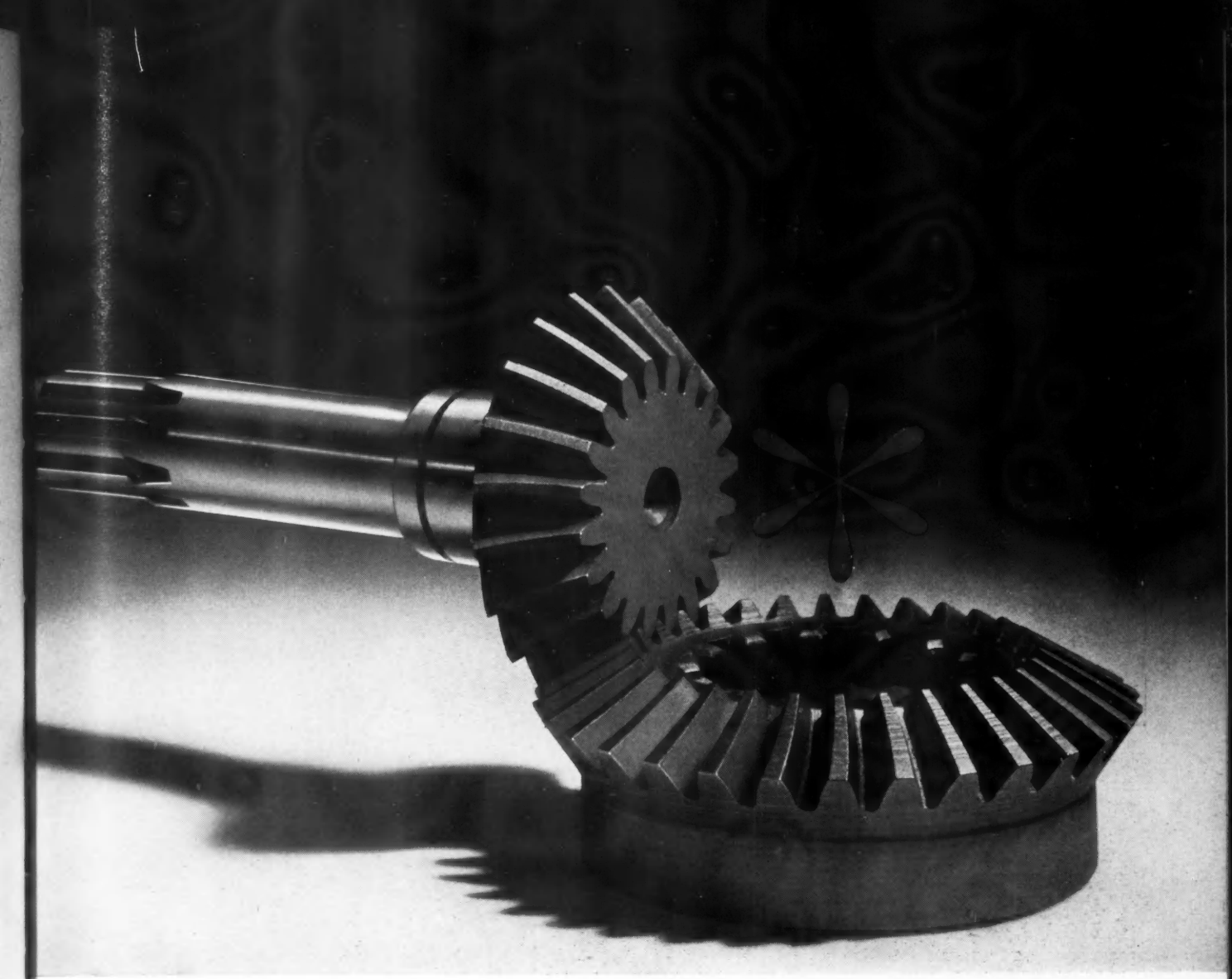
Out of a vigorous, competitive buyer's market for goods will come a healthier period of labor relations, too, in my opinion. Labor has a great stake in the competitive system of which we are all beneficiaries. Labor also has a stake in profitable distribution of goods and services—in achieving the corporate incomes which are possible in the mass production field only when

(*Turn to page 67, please*)

In the new cars now reaching the public, a high level of performance will be maintained by effective control of motor temperatures. This is the function of Dole Thermostats. They assure quick warm-up — with important savings in gas, oil and motor wear through reduced crank case dilution.

DOLE
Thermostats
In a Range of Types for Every Car

THE DOLE VALVE COMPANY
1901-1941 Carroll Ave., Chicago 12, Illinois
Los Angeles • Detroit • Philadelphia



* Here's a tooth for an eye that's watching costs

IF YOU need gears that eliminate the end thrust characteristics of conventional spiral bevels—yet retain their smoothness, strength, and tooth bearing localization—the zerol bevel gears shown above may fit your picture. Notice the ends of each tooth are on a radial line, yet each tooth is curved, bringing the quiet operation and cost-saving advantages of two designs into one.

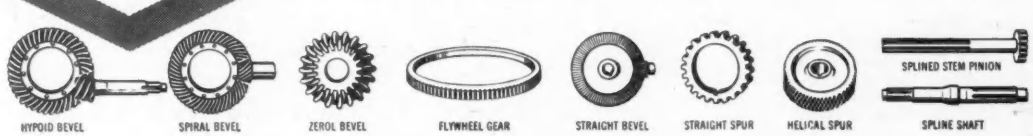
There's more to these gears than meets the eye, however. You cannot see, for instance, the men and machines that shape their future . . . the little details of manufacture no one of which can safely be slighted, if the integrity of our trade mark is to be upheld. The Double Diamond mark may not show in the final assembly—*but someone's trade mark does.* And if your trade mark depends in part on gear performance, we have a record of *specifications met or exceeded* that will interest you.

DOUBLE DIAMOND
TRADE MARK
GEARS

Made by

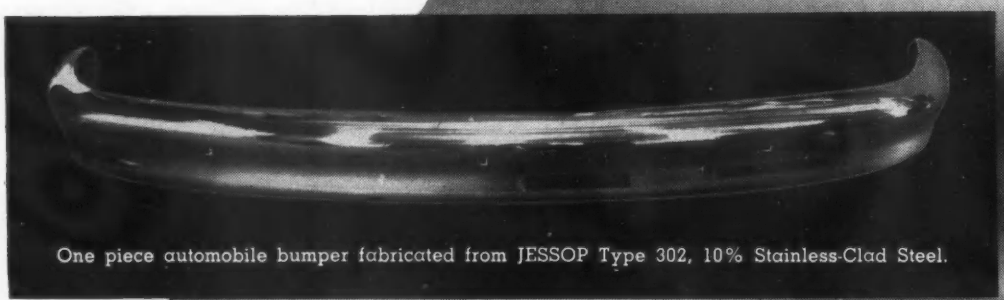
AUTOMOTIVE GEAR WORKS, INC.
RICHMOND, INDIANA

FOR AUTOMOTIVE, FARM EQUIPMENT AND GENERAL INDUSTRIAL APPLICATIONS



Automobile Bumper Design and Fabrication

advances With ____ JESSOP STAINLESS-CLAD STEEL*



One piece automobile bumper fabricated from JESSOP Type 302, 10% Stainless-Clad Steel.

Recently completed trial production runs for the fabrication of JESSOP Stainless-Clad Steel into bumpers, bumper guards, and gravel guards have proved the usefulness of stainless-clad from the standpoints of both production and sales. Production-wise, JESSOP Stainless-Clad parts are easily formed in the same dies used for ordinary steels; sales-wise, JESSOP Stainless-Clad parts will take a beautiful, lustrous finish which will not peel, chip, or flake, and they will remain free of rust or tarnish during the life of the car.

The designer and fabricator of new or redesigned automobile accessories will benefit greatly in today's and tomorrow's competitive market by the many advantages that JESSOP Stainless-Clad Steel has to offer over parts formerly plated or die cast. Our Engineering Service Department will be glad to help you apply Stainless-Clad Steel in the places where it can serve most advantageously. You will find complete information in our catalogue, sent on request.

JESSOP Stainless-Clad Steel is made by a patented process whereby stainless steel of uniform thickness is inseparably united to a mild steel backing. Degree of cladding can be varied from 5 to 50%, depending upon the total gauge of the composite metal. Among the many advantages of JESSOP Stainless-Clad Steel are the following:

- A permanent, corrosion resistant surface on the stainless side which will not chip, peel, or flake.
- Mechanical strength supplied by the mild steel backing.
- Easily cold formed in the same dies now being used for other metals.
- Stainless surface is extremely tough and durable. Accidental scratching or gouging is easily repaired.

*Manufactured under U. S. Pat. Nos. 1,997,538; 2,044,742; 2,147,407 and 2,225,862. Can. Pat. No. 383,153.

JESSOP STEEL COMPANY

WASHINGTON, PENNSYLVANIA

Tailor-made Specialty Steels

output is great and costs are low enough to permit low prices and even greater output. The wealth which all of us will divide is not Money but Products. The only way to achieve that wealth is for all of us to work for it. There cannot be real wealth in a free country unless there are goods and services for all—and the way for more goods and services for all is more work — more productive work!

News of the Industry

(*Continued from page* 48)

estimated replacement parts requirements could be produced.

In view of this report, it should be noted that while there is a very good possibility of a 5 million car and truck production this year, the supply of raw materials also should be better than it was last year, especially after mid-year. Another factor is that with the more plentiful supply of new cars, the replacement parts requirements may taper off more than has been estimated. Nonetheless, the parts industry certainly is going to have good business in 1947 from both original and replacement parts sales.

Packard Increases Prices

Price rises equalling a weighted average of $62 per car, after allowing for a spare tire now being shipped as standard equipment on all 1947 models, were announced Jan. 6 by the Packard Motor Car Co.

Low volume, higher material prices and continued inefficiency of labor were quoted as necessary reasons for the move by Packard president Geo. T. Christopher.

"Even after these price increases, we still expect to lose approximately $80 a car until we reach much higher production," Mr. Christopher said. "Nor does this loss take into account the latest demands of labor for wage increases and alleged portal-to-portal pay."

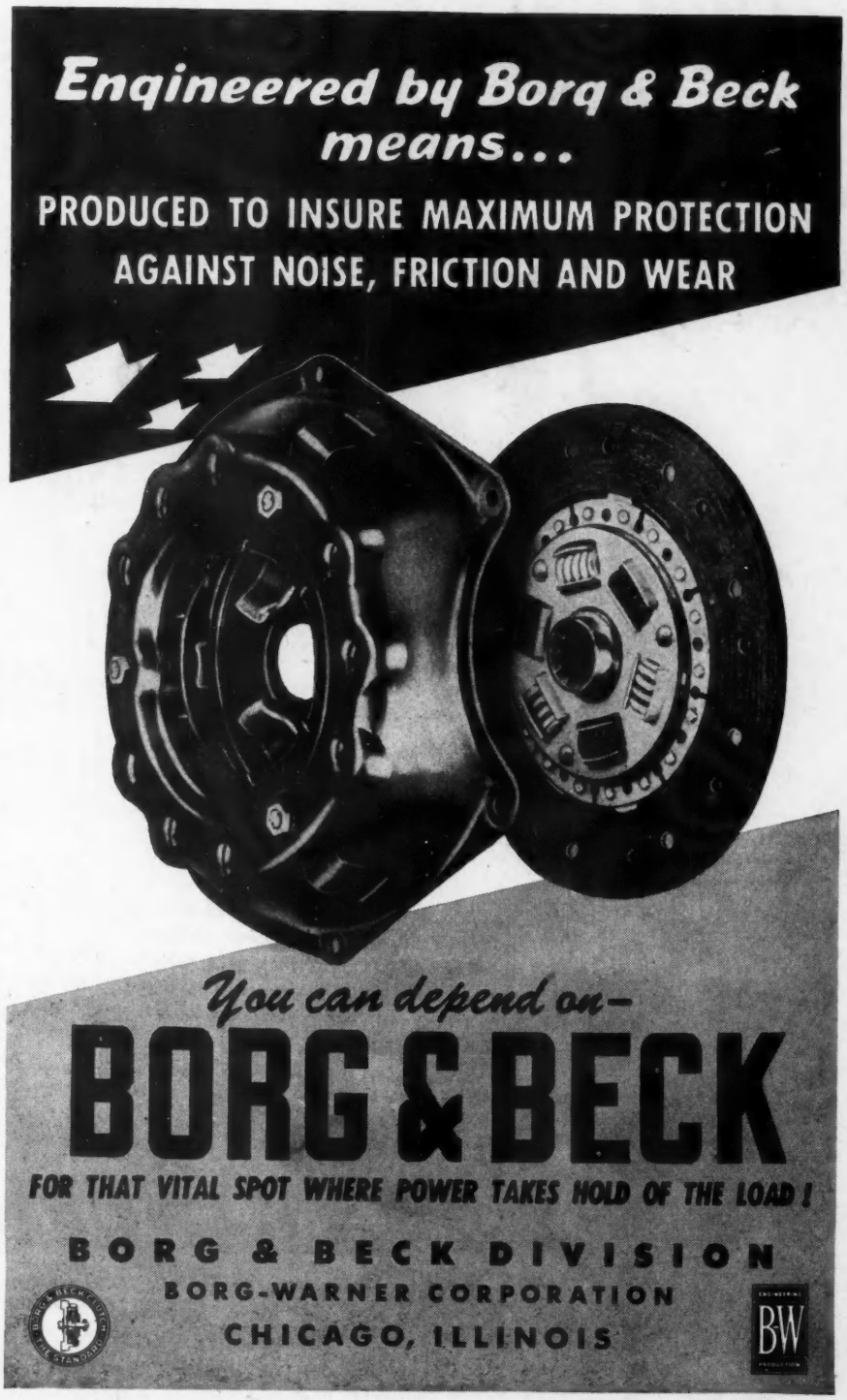
Ford Car Prices Reduced

Henry Ford II, president of the Ford Motor Co., on Jan. 15 announced price reductions in Ford cars ranging from $15 to $50. Detroit delivered prices of 1946 models, before and after the price cut, are shown in the table below.

	Old Price	New Price
De Luxe 6		
Tudor	$1,215.46	$1,188.36
Super De Luxe		
Tudor	1,313.02	1,258.82
Fordor	1,378.06	1,323.86
Sedan Coupe	1,361.80	1,307.60
De Luxe 8		
Tudor	1,269.66	1,242.56
Super De Luxe 8		
Tudor	1,367.22	1,350.96
Fordor	1,431.20	1,414.94
Sedan Coupe	1,413.84	1,386.74
Conv. Club Coupe	1,601.39	1,585.13

Automobile Companies List Production for Last Year

Production figures released by several automobile builders covering 1946 output stress the difficulties encountered last year. General Motors built 827,849 passenger cars, 55 per cent below the record 1,818,481 turned out in 1941. Truck production last year was 306,438 units, 33 per cent under the 1941 figure. The Ford 1946 production total shows 656,135 units, compared with 896,482 in 1941. The Ford breakdown last year was 372,917 Ford, 70,955 Mercury, and 13,496 Lincoln passenger cars, and 198,767 trucks. Nash reported that it passed its 1941 production in 1946, when it built 98,769 automobiles, compared with 80,408 the last prewar year. However, the company was producing at the rate of 145,000 units a year, as 1946 ended, which is about 60 per cent of capacity. Studebaker had its sixth best year in history, production-wise, in 1946 despite hampering shutdowns and scarcities of supplies. The company turned out 120,723 passenger cars and trucks. Commercial vehicle production last year was up 339 per cent over the 1941 level.


Engineered by Borg & Beck means...
PRODUCED TO INSURE MAXIMUM PROTECTION
AGAINST NOISE, FRICTION AND WEAR
You can depend on—
BORG & BECK
FOR THAT VITAL SPOT WHERE POWER TAKES HOLD OF THE LOAD!
BORG & BECK DIVISION
BORG-WARNER CORPORATION
CHICAGO, ILLINOIS
BW

Make the
CRITICAL ACCURACY
you build into your machines
EASY TO MAINTAIN

MOST EQUIPMENT MAKERS who utilize Laminum in accurately fitting gear mesh and bearings do so primarily to reduce precision machining. But the same shim also assures accuracy of future service adjustments . . . too important to overlook. Bulletin on request

Laminum shims are cut to your specifications, but for maintenance work, shim materials are sold through industrial distributors.

Laminated Shim Company, Incorporated
51 Union Street • Glenbrook, Conn.

LAMINUM
TRADE MARK
THE SOLID SHIM THAT peels FOR ADJUSTMENT

2216

SAE Annual Meeting

(*Continued from page* 54)

interested in his job and to feel that he is a member of a real community."

In addition to the keen interest manifested in the technical sessions, the attention of many members was centered in committee meetings dealing with the gamut of problems facing the Society. This year committee activity overtaxed the capacity of the headquarters hotel and made it necessary to schedule meetings at the Rackham Building and the General Motors Building as well. Supplementing the SAE committees, there were sessions of the CRC and the annual meeting of the Independent Research Committee for cutting fluids under the chairmanship of Joseph Geschelin. The IRC has undertaken a nation-wide survey of cutting fluids practice in the metal working field and will aim at the preparation of an up-to-date analysis as well as recommendations to industry.

Besides the technical sessions and committee meetings there was a well patronized exhibit in which many interesting new developments were included. Abstracts of the principal papers presented at the technical sessions will be published in the next issue of AUTOMOTIVE AND AVIATION INDUSTRIES.

Publications Available

(*Continued from page* 52)

Riveting Machine Applications

The H. P. Townsend Mfg. Co.—This company has recently inaugurated a monthly bulletin, "The Townsend Riveter," giving case studies of riveting and allied problems which come to the Townsend engineering department. Bulletins will show the wide variety of applications to which riveting machines can be put.

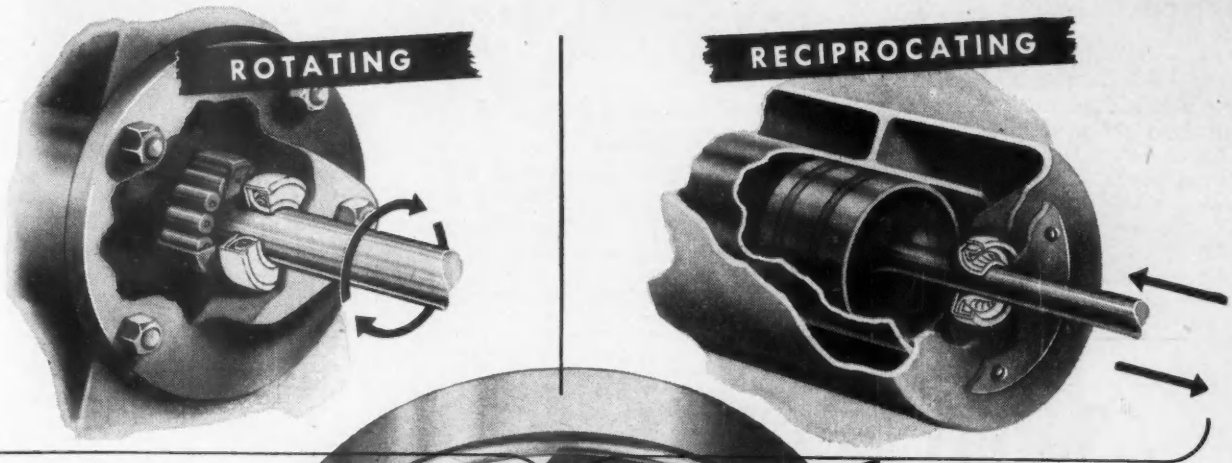
Protective Coating

United Chromium Inc.—A four-page descriptive folder on "Ucilon" protective synthetic coating gives properties, application data, and typical uses of this protective coating that resists severest corrosive conditions. Developed from improved, inert, synthetic resins, this material is said to be especially advantageous for maintenance work, and for products subjected to corrosive service.

Sheet Metal Equipment

Newcomb-Detroit Co.—A catalog and handbook of engineering data concerning the company's products. Spray booths, ovens, metal parts washers, dust collectors, exhaust and ventilating systems, carburizing systems, and other sheet metal equipment are described and illustrated.

The Simple Effective Way to Seal Shafts



"PERFECT" *Oil Seals*

PATENTED

THEY DO:	THEY DO NOT:
1—Retain lubricant	1—Permit entrance of foreign matter
2—Prolong bearing life	2—Need adjustment or attention
3—Reduce bearing maintenance	3—Rotate with the shaft
4—Use little space	4—Wick lubricant away from bearing
5—Cost very little	5—Score the shaft

Consult Chicago Rawhide Engineers for Specific Application Information

CHICAGO RAWHIDE MANUFACTURING COMPANY 25

1310 ELSTON AVENUE • CHICAGO 22, ILLINOIS

PHILADELPHIA • CLEVELAND • NEW YORK • DETROIT • BOSTON • PITTSBURGH • CINCINNATI

67 YEARS MANUFACTURING QUALITY MECHANICAL LEATHER GOODS EXCLUSIVELY AND NOW SIRVENE SYNTHETIC PRODUCTS

New Products for Aircraft

(*Continued from page* 43)

which automatically turns the loop in the direction of the transmitting station, and at the same time turns the pointer of the azimuth indicator.

The azimuth indicator incorporates the quadrantal error correcting mechanism so that the indicated bearings are not affected by the electromagnetic effect of the airplane's structure. The 360-deg azimuth scale is rotatable, and can be set by the pilot to give him his radio bearings as relative, magnetic or tune.

Loudspeaker reproduction is provided, for the pilot and passengers, as standard equipment, or the pilot may use his headset alone.

Slug—A-P 2; one cut

Bendix Landing Gear for Light Planes

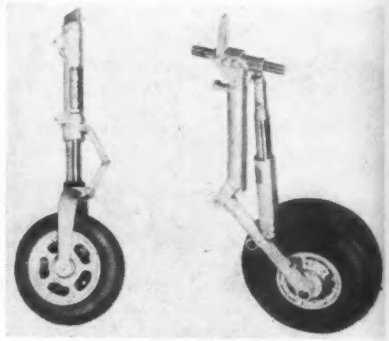
The Bendix Products Division of the Bendix Aviation Corp., South Bend, Ind., now offers shock-absorbing main and nose struts, brakes, and wheels for the private flyer type of light planes.

The main landing gear illustrated is a recently completed development for a 1500-lb private airplane. It is of the retractable type with levered suspension. It is claimed that the basic principle of this design may be equally adaptable to low cost cantilever type retractable struts.

The shock absorbing element consists of a simplified version of the air-oil shock strut. It is light and compact, yet has large impact absorbing capacity. The design of the packing gland is such as to insure against leaks and maintain air pressure for long periods. The strut may be "inflated" in service with a tire pump or from the ordinary low pressure air line usually used for tires.

The nose strut and wheel assembly shown has been developed for a light airplane of the privately owned type. Provisions for steering and retracting are incorporated while self-centering can be provided if desired. The design is equally adaptable to non-steerable nose gears. Shock absorbing features of this cantilever design are similar to those for the main strut described above. The brake is contained entirely within the wheel.

The mounting on the strut spindle is by means of mating hexagonal members that eliminates the usual mounting flange, bolts, nuts, etc. The stationary member of the brake is held upon the hexagon section of the spindle by means of one end-nut.



Left—Bendix steerable nose strut and wheel. Right—Bendix retractable lever-suspended main landing gear

The heat absorbing element is a floating rotor, which is in friction contact during brake application with a lined non-rotating stator or pressure plate on one side, and with rotating lining segments attached to the wheel on the other side. Contact pressure is from a hydraulic pressure ring which is in the outer member shown at the extreme left in the illustration.

Segmented linings on the fixed member as well as on the wheel have the advantages of allowing ventilation space and scavenging lining dust; the result is said to be high braking capacity with minimum hydraulic pressure.

The design is claimed to be adaptable to a wide range of airplane weights and landing speeds.

- Buell Air Horns are tops in warning signal efficiency.
- Installed as original equipment on many Trucks and Buses.
- They reduce maintenance costs by decreasing stops, starts and slowdowns.
- All records prove that they save tires, brakes, clutches and gears.
- Cut gas and oil consumption.

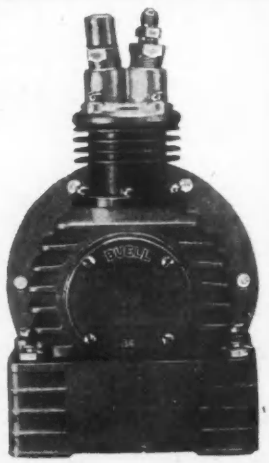
With a Buell the driver has greater security, maintaining a steady cruising speed. Slowing a 20 ton load from 50 MPH to 30 MPH means destroying a lot of energy thru brake lining and tires. It is replaced by burning more gasoline, increasing load on engine, and tires again, to regain speed. This all costs money. We believe a Buell Air Horn is worth $100.00 yearly on any heavy highway vehicle. Then remember a Buell will last more than 10 years. How would you rate a $100.00 investment that earned $100.00 yearly for 10 years. Ask the man who has a Buell.

BUELL AIR COMPRESSOR

- Used on Passenger Cars, Trucks, Buses, Boats and Planes.
- Small and compact in size . . . efficient and powerful in action.

Buell engine-driven compressors supplied air to operate air brakes in thousands of R.C.A.F. aircraft. Only a combination of quality and precision workmanship could meet the requirements of this type of service.

Designed for compactness and light weight, they are far more efficient and powerful than their size indicates. Let us prove their adaptability to your needs.

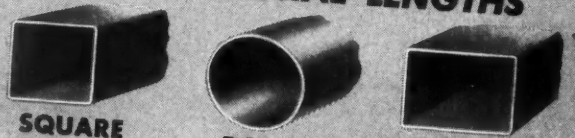


BUELL MANUFACTURING CO.
2975 Cottage Grove Ave., Chicago 16, Ill.

MICHIGAN WELDED STEEL TUBING

ROUND, SQUARE, RECTANGULAR AND SPECIAL SHAPES

- IN COMMERCIAL LENGTH
- CUT TO SPECIAL LENGTHS



SQUARE	ROUND	RECTANGULAR
½" to 2¾" 14 to 20 gauge	¼" to 4" O. D. 9 to 22 gauge	½" to 2¾" 14 to 20 gauge

Adaptability!

Michigan Welded Steel Tubing is available in sizes and shapes that make it readily usable in the production of a wide variety of parts.

Whether you form and machine the parts in your plant or order them prefabricated by Michigan, you will find this tubing exceptionally uniform in structure and adapted to reworking by any production process. Michigan welded tubing can be:

Engineering advice and technical help in the selection of tubing best suited to your needs. Address your inquiries to:

Michigan STEEL TUBE PRODUCTS CO.

More Than 25 Years in the Business

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FACTORIES: DETROIT, MICHIGAN • SHELBY, OHIO

DISTRIBUTORS: Steel Sales Corp., Detroit, Chicago, St. Louis, Milwaukee and Minneapolis—Miller Steel Co., Inc., Hillside, N. J.—C. L. Hyland Dayton, Ohio—Dirks & Company, Portland, Oregon—James J. Shannon, Milton, Mass.—Service Steel Co., Los Angeles, Calif.—American Tubular & Steel Products Co., Pittsburgh, Pa.—Strong, Carlisle & Hammond Co., Cleveland, Ohio—C. A. Russell, Inc., Houston, Texas—Drummond, McCall & Co., Ltd., Toronto, Canada.

New Production Equipment

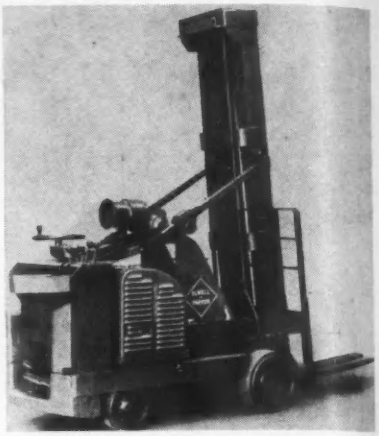
(*Continued from page* 42)

at the control panel is only 4 ft 2 in. above the floor level. Operator stands on a small platform 1 ft above the floor.

One pair of columns forms a primary frame, the bottom of which is pivoted at the forward base of the truck body. Height of this frame is 11 ft above floor level. A second pair of columns, virtually the same length as the primary, forms the telescoping frame. Thus, there are only two sections in the elevating system.

The secondary frame operates on ball-bearing rollers in alloy steel tracks which form part of the primary frame. The adjustable fork is attached to a steel plate with flanges which travel in the secondary frame. Chains are attached to this plate and it rises to the peak of the primary before the secondary frame is engaged. The latter then moves upward, carrying with it the fork and load.

The secondary frame is never actuated below heights of 11 ft, in fact, its presence is not apparent until the fork is lifted beyond that height.



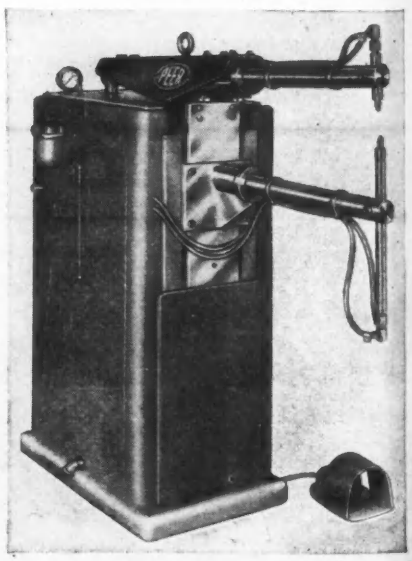
Elwell-Parker fork-type power industrial truck

Truck is mounted on four wheels and is driven by means of the forward pair, size 7 x 20 in. Rear wheels, through which steering is accomplished, are 5 x 15 in. Wheels have solid rubber tires.

A NEW SERIES of fully automatic, air-operated, rocker arm spot welders is offered by Pier Equipment Manufacturing Co., Benton Harbor, Mich.

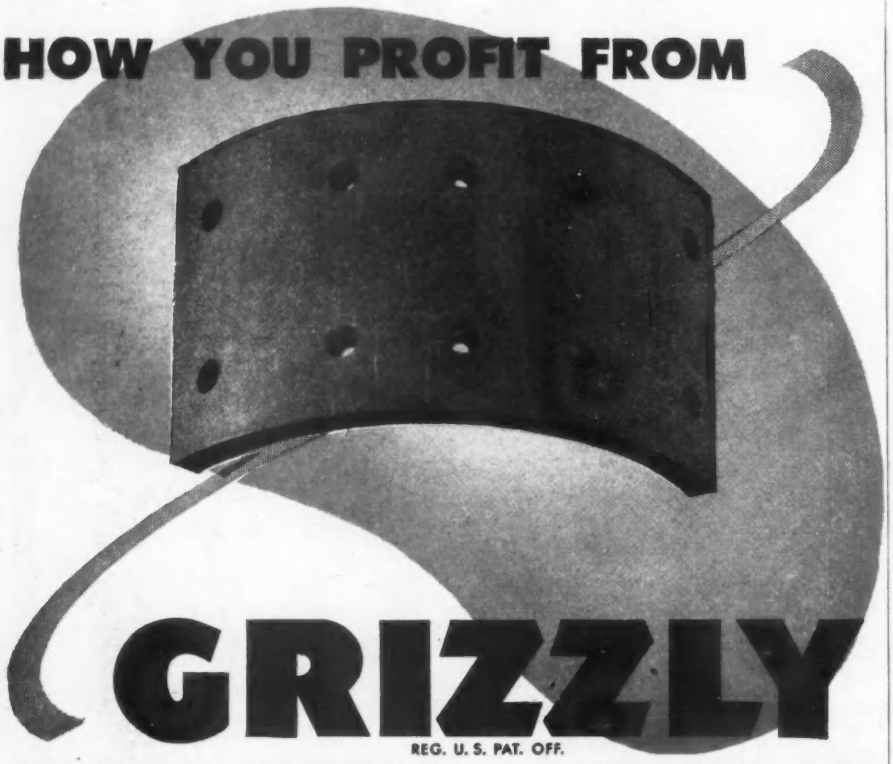
These Series A-200 welders incorporate a double-acting air cylinder of ample size to provide the high electrode pressure essential for high production of quality welds. The rocker arm is mounted on roller bearings and hammering of the electrodes is minimized by the light weight welded steel construction of the rocker arm assembly. Minimum obstruction on the front of the welder and around the rocker arm assembly facilitates the handling of large or irregular shaped parts, and efficient electrical design is claimed to

(*Turn to page* 74, *please*)



Series A-200 Peer welder

HOW YOU PROFIT FROM



GRIZZLY

REG. U. S. PAT. OFF.

BRAKE LINING EXPERIENCE

Grizzly has produced fine quality brake lining for over 30 years, and the experience gained through these years pays rich dividends to Grizzly users.

Experience, in both automotive and industrial fields, has enabled Grizzly to solve brake lining problems of widely divergent natures. Grizzly experience has been of utmost value in Grizzly research and study of new brake lining developments, and this same experience has helped establish Grizzly as one of the largest, most dependable producers of molded brake lining.

Do as other production, engineering and purchasing men have long been doing —take your brake lining problems to Grizzly. Get full advantage of Grizzly's many years of brake lining experience.

GRIZZLY MANUFACTURING COMPANY
PAULDING, OHIO
PLANTS AT PAULDING AND BELL, CALIF.
Warehouse Stocks in Principal Cities

YOU CAN SHAVE A GEAR A LOT FASTER than you can grind it

Gears requiring 40 minutes (floor to floor) for grinding are being shaved in just 5 minutes.

The shaved gears are just as accurate dimensionally as the ground gears; tooth surfaces are just as smooth and of equal if not greater importance, the shaved gear teeth are entirely free of those prevalent hairline grinding cracks which so often result in fatigue failures. Thus by shaving you get better gears faster and at less production cost.

Gears are shaved on Red Ring Rotary Shaving Machines which produce smooth tooth surfaces and correct errors of helical angle, profile and eccentricity. Gears from 3/16" to 220" P. D. can be shaved. Those from 3/8" to 36" P. D. can also be crowned to avoid the danger of failure due to "End Bearing."

NATIONAL BROACH AND MACHINE CO.

5600 ST. JEAN — RED RING ◯ PRODUCTS — DETROIT 13, MICH.

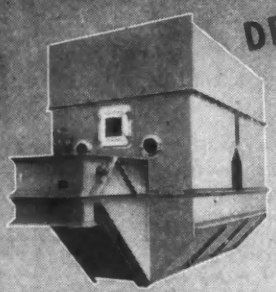
SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

Engineering Library

Schmieg
CENTRI MERGE
PRODUCTION FINISHING SYSTEMS
SPRAY BOOTHS
FRESH AIR SUPPLY SYSTEMS
OVENS—DRYING and PROCESSING
DESIGNED . . . BUILT . . . INSTALLED to Synchronize with Your Production Line . . .

If you are contemplating a new installation, or a rearrangement of your present equipment that involves any of the products listed above, Schmieg engineers can be of valuable assistance. They will gladly make recommendations to meet your production requirements without cost or obligation to you.



CENTRI-MERGE Collection Units are available in capacities to handle any air cleaning job—small or large. May be installed singly or in batteries, depending upon volume of air to be handled.

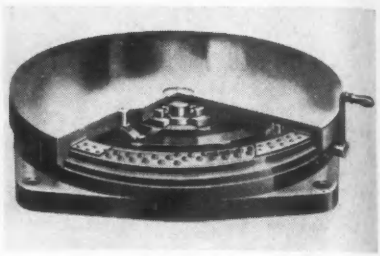
THE best AIR PURGE is CENTRI MERGE

Schmieg INDUSTRIES INC.
Engineers & Manufacturers
310 PIQUETTE AVE. • DETROIT 2, MICH.

provide a lower power demand for a given welding job.

Standard equipment includes foot switch control, air pressure regulator, universal horns, water-cooled electrode holders, and one set each of straight and offset copper alloy welding points. Series A-200 Peer welder capacities are 10 and 15 kva with throat depths of 8 in., 12 in., 18 in., 24 in., and 30 in.

ROBBINS ENGINEERING CO., 318 Midland Ave., Detroit 3, Mich., is manufacturing a table for fast, accurate indexing on a wide variety of production operations. The table is in-



Robbins index table

dexed manually—located automatically. To index, the crank handle is turned to horizontal which disengages a large diameter locking pin—as the table is indexed the handle is released and the table is locked in the next position automatically. The location of the index positions is determined to suit the

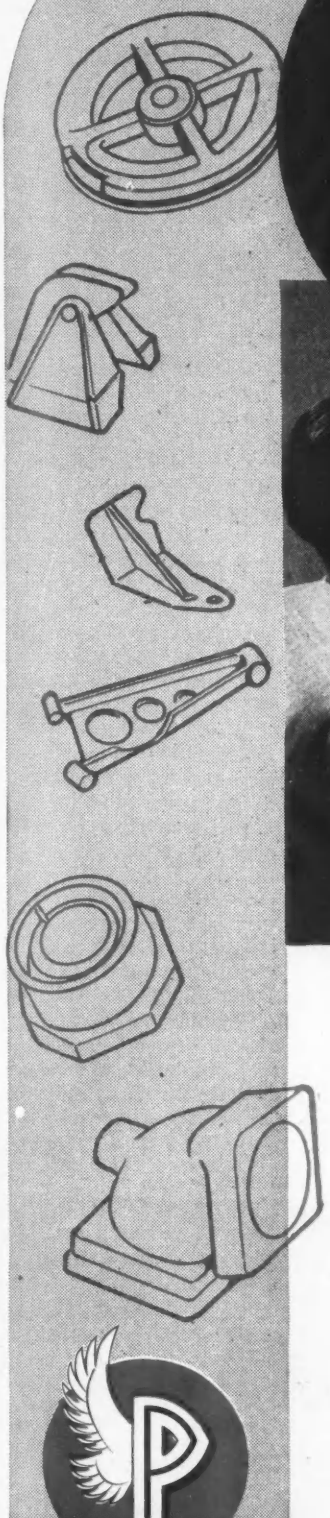
(*Turn to page 76, please*)

Men-E-Uses Power Drive

This variable-speed power drive is said to meet any fractional-hp drive requirement. It has a range from 20 to 750 rpm with 1750-rpm motors, and can get down to four rpm with an additional auxiliary shaft which is optional equipment. Base and housing are aluminum. Weight is 12 lb. Universal motor mount takes up to ½-hp motors. Power drive operates in either direction. The Men-E-Uses power drive is made by the Flinchbaugh Co., 750 S. Court St., New York, N. Y.

How PERMITE Controls the Quality ...of YOUR ALUMINUM ALLOY CASTINGS

One step in the complete system of Permite Quality Control is spectrographic analysis – to determine that the metal in the furnace fully meets alloying specifications.



● Nothing is left to chance in assuring uniformly high quality of Permite Aluminum Alloy Castings.

From indoor storage of the metal to prevent oxidation, to degassing during the melting process to remove harmful gases and impurities, to spectrographic metal analysis for accurate alloying, scientific watchfulness guards every successive step of production.

Permite's inspection procedure includes such advanced equipment as the Optical Comparator and the Angle Computer for quick and accurate dimensional checking of the most intricate castings; X-ray laboratories for both fluoroscopic and radiographic inspections; the Magnaflux Zyglo for detecting any surface imperfections invisible to the naked eye.

This assurance of uniform quality saves time in final assembly and brings real production economies to users of Permite Aluminum Castings. Send us blueprints and specifications for recommendations and quotations on your parts requirements.

PERMITE

ALUMINUM INDUSTRIES, INC.

CINCINNATI 25, OHIO

DETROIT: 809 New Center Building. NEW YORK: 9 Rockefeller Plaza. CHICAGO: 64 E. Jackson Boulevard. ATLANTA: 413 Grant Building.

ALUMINUM PERMANENT MOLD, SAND and DIE CASTINGS...HARDENED, GROUND and FORGED STEEL PARTS

application. A safety stop permits indexing in one direction only.

It is claimed that this index table is fully supported by a large, specially designed ball bearing which eliminates out-of-parallel-conditions due to vertical thrust from cutting tools or heavy parts located off-center on the table. Special design of the support bearing also prevents brinelling of the races. An anti-friction radial mounting produces effortless indexing.

All wearing parts are hardened and ground and are concealed from dirt, chips, abrasives, etc. The index table and base are ribbed for extra strength.

THERMOID Co., Trenton 6, N. J., has brought out a general service hand truck built to handle the heaviest loads practical for manual trucking. This truck is 53 in. high by 18 in. wide with 9-in. wheels. It is made of aluminum alloy castings and with a steel nose. Its light weight is said to be accomplished at no sacrifice of wear-resisting strength.

The manufacturer points out that ease of operation results from four points; light weight of structural materials, perfect balance, a long 7-in. steel nose that makes "breaking" a load easier, and solid-rubber-tired, easy-rolling, ball-bearing wheels.

Thermoid general service hand truck

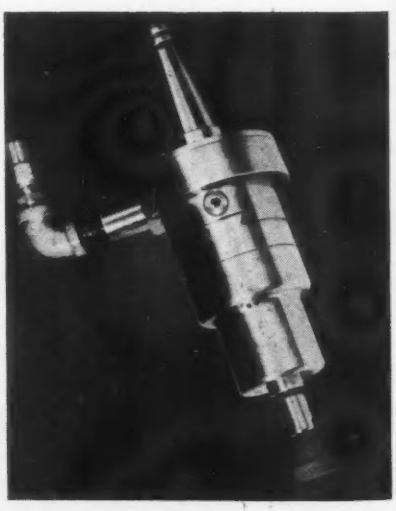
The tires are solid and cut resistant. Heavy-duty ball bearings have a built-in grease seal that prevents dust or dirt from reaching the bearing and also prevents grease leakage from a large built-in grease reservoir.

Thermoid Co. will also market a complete line of 6-in., 8-in., 9-in., 10-in., and 12-in. aluminum wheels for general industrial application.

A HIGH SPEED, air-driven attachment called the Vulcanaire, which converts jig borers and other machine tools into precision jig grinders, has just been developed by the Vulcan Tool Co., Dayton, Ohio.

The Vulcanaire is equipped with an adaptor that fits into the chuck of any machine tool when the operation requires precision jig grinding. It has controllable speeds ranging from 30,000 to 75,000 rpm. From four to eight cu ft of air per minute is all that is required for the complete speed range. The unit is 2½ in. in maximum diameter and, exclusive of adaptor and

(*Turn to page 8, please*)

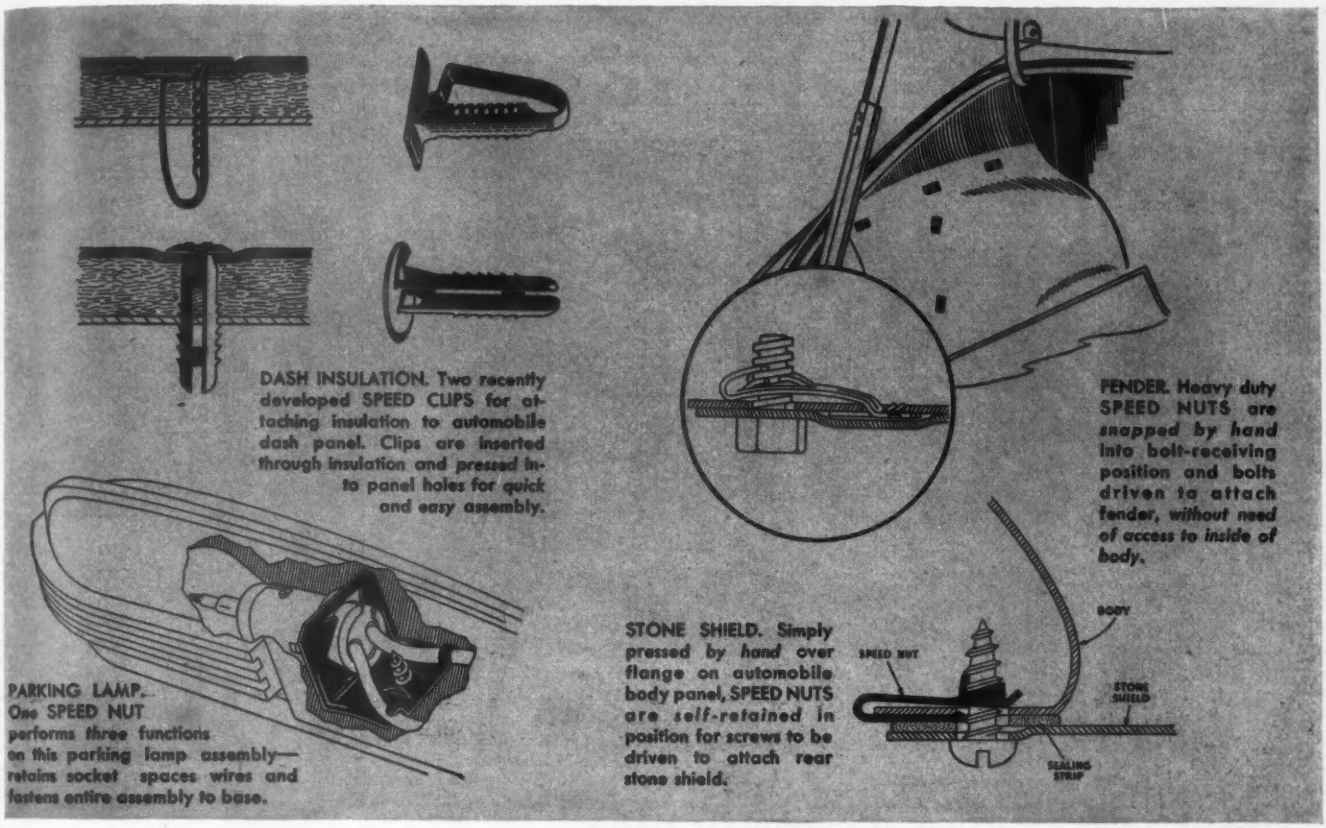


Vulcanaire air-driven attachment for jig borers

Production!
Carefully planned production methods . . . coordinated scheduling of materials . . . tools and machines designed for the manufacture of a specific product . . . these are factors that assure a constant flow of precision-built Atwood Clutches to our customers.
THE ATWOOD CLUTCH COMPANY, AUBURN, INDIANA, U. S. A.

Consider the fastener!

More and more Engineers are recognizing its true importance!


DASH INSULATION. Two recently developed SPEED CLIPS for attaching insulation to automobile dash panel. Clips are inserted through insulation and pressed into panel holes for quick and easy assembly.
PARKING LAMP. One SPEED NUT performs three functions on this parking lamp assembly—retains socket spaces wires and fastens entire assembly to base.
FENDER. Heavy duty SPEED NUTS are snapped by hand into bolt-receiving position and bolts driven to attach fender, without need of access to inside of body.
STONE SHIELD. Simply pressed by hand over flange on automobile body panel, SPEED NUTS are self-retained in position for screws to be driven to attach rear stone shield.
BODY
SPEED NUT
STONE SHIELD
SEALING STRIP

Design and Assembly Engineers, who perform seeming miracles every day, are fast becoming fastener conscious. For, with improved fasteners, even greater advantages are gained. Assembly is made faster and less costly. Fewer parts are used. Weight is reduced. And—that old bugaboo, "vibration loosening" is licked once and for all.

Tinnerman SPEED NUTS, widely used in place of ordinary threaded nuts and lock washers for better assembly, are also made in hundreds of special designs. With them, engineers can accomplish today what was impossible yesterday. SPEED NUTS open the door to design possibilities never before fully explored. Look over the sketches above. These are but a few of hundreds of SPEED NUTS designed by Tinnerman to meet special needs. Possibly they will give you an idea of what can be done to secure better fastenings for *your* products.

If we can be of any help, why not write us today. Send complete details or, better still, send the product itself. We'll be glad to give you a complete fastening analysis.

TINNERMAN PRODUCTS, INC.

2059 Fulton Road • Cleveland 13, Ohio

In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In France: Aerocessoires Simmonds, S.A., Paris
In England: Simmonds Aerocessories, Ltd., London
In Australia: Simmonds Aerocessories, Pty. Ltd., Melbourne

Speed Nuts* PATENTED

MORE THAN 4000 SHAPES AND SIZES

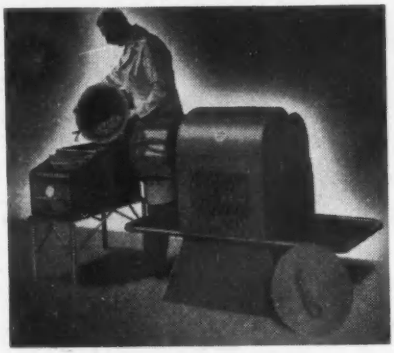
*Trade Mark Reg. U. S. Pat. Off.

FASTEST THING IN FASTENINGS

grinding wheel, is 7½ in. overall. Precision grinding of holes from 1/16 in. to 1½ in. can be accomplished. The complete unit includes adaptor to fit any specific machine tool, together with dust collector, air filter, pressure gage and oiler.

In addition to jig grinding applications, the Vulcanaire is produced in models for adapting lathes, milling machines and internal and surface grinders for other high speed precision grinding.

STURGIS PRODUCTS CO., Sturgis, Mich., has added a new Roto-Finish midget-size machine to its line of finishing and de-burring machines. Cylinders of the new Roto-Finish Midget are 8 in. wide and 12 in. across the flats. It has a variable drive of 35 to 70 rpm. Flats are lined with hard maple, and ends are rubber sealed. The cover is secured to the cylinder, and cylinder mounted on machine by a lock and adjustable clamp. The machine can be supplied without base for bench mounting. A hand parts separator is supplied and is equipped with drain connection. Interchangeable screens are available in all mesh sizes for separation of chips from parts.



Roto-Finish midget-size machine

All mechanical finishing operations may be performed in the Roto-Finish Midget — grinding, de-burring, polishing, britehoning and coloring. The controlled rotary action of the wet mixture of Midget chips and compound produces a surface suitable for plating by removing uniformly burrs, sharp edges and corners on small stampings, machined parts, and die castings.

MABOR CO., Clark Township, Rahway, N. J., has now produced a turntable type washer, which both rinses and dries average sized parts in baskets, trays or individually.

This unit requires only one operator to load and unload the parts for cleaning. In addition, the turn-table washer

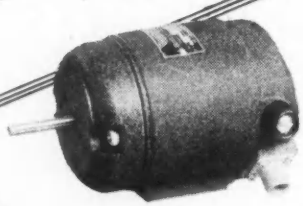
(*Turn to page 80, please*)

Product Performance You'll Be Proud of with *Lamb Electric* motors

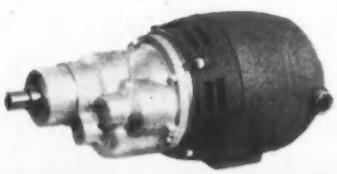
Specially designed for each particular application and with dependability built into every part, Lamb Electric Motors have established a reputation for long, trouble-free operation.

This quality of motor performance is an important factor in obtaining the high standard of product performance that is the aim of every manufacturer.

THE LAMB ELECTRIC COMPANY
KENT, OHIO



Small, sturdy motor that can be readily adapted to a wide range of industrial applications.



Light-weight universal motor with efficient spur gear speed reducer.

Lamb Electric
FORMERLY *Black & Decker Electric*
SPECIAL APPLICATION FRACTIONAL HORSEPOWER **MOTORS**

Micro Drill Chuck

This is an exploded view of the adjustable collet chuck developed by Chicago-Latrobe Twist Drill Works, 411 W. Ontario St., Chicago 10, Ill. It will be available in two different size collets, the smaller ranging from .005 in. to .025 in. and the larger from .020 in. to .040 in. Principal feature of this adjustable collet chuck is that it can be adjusted to absolute concentricity

THE NEW ARITHMETIC IN STEEL

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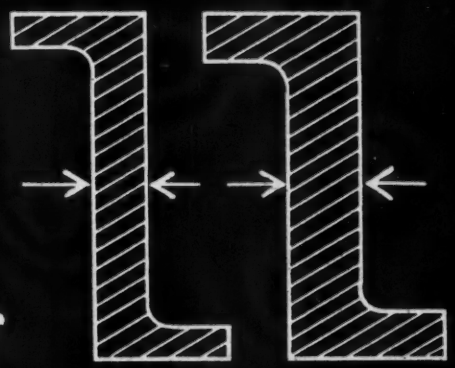
GREAT LAKES STEEL CORPORATION

LIGHTER SECTIONS



=LESS STEEL PER UNIT

=MORE UNITS PER TON

THIS NEW ARITHMETIC SHOWS USERS OF HOT AND COLD ROLLED SHEETS HOW TO INCREASE PRODUCTION OF UNITS 33% WITH THE SAME AMOUNT OF STEEL

Here's a proved and practical answer to the problem of increasing production.

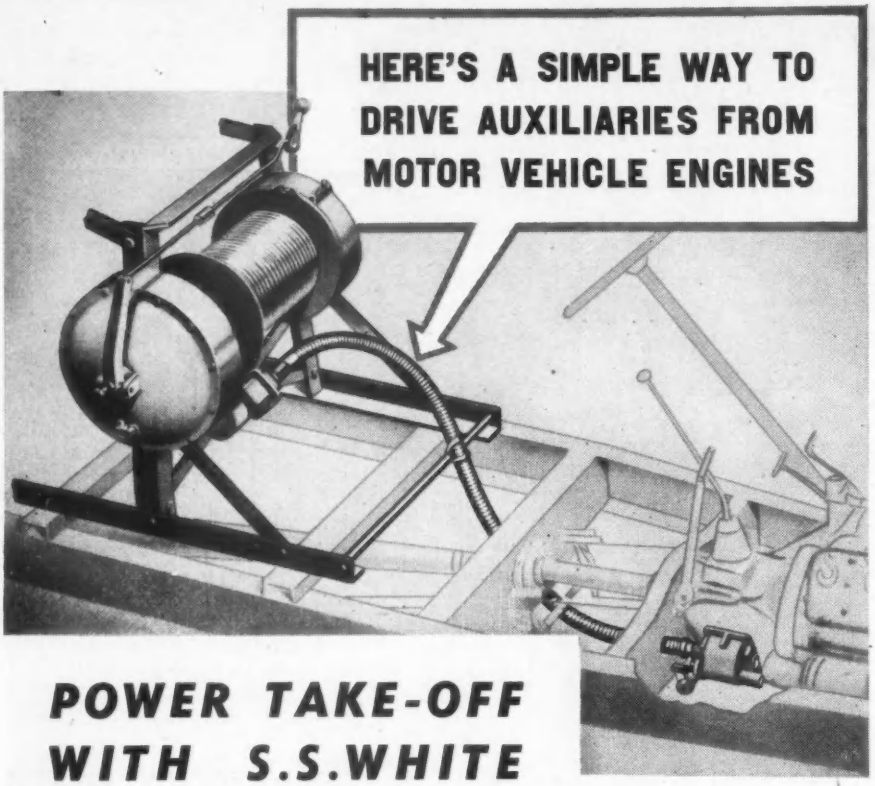
Make lighter sections of N-A-X HIGH-TENSILE steel. Use less steel per unit, get more units per ton. This low-alloy steel is so superior in tensile strength to carbon sheet steel that three tons will ordinarily do the work of four. Yet, with all its strength, N-A-X HIGH-TENSILE can be formed and drawn to intricate shapes because of its exceptional ductility.

You'll find other important advantages in N-A-X HIGH-TENSILE steel—excellent weldability, high fatigue- and corrosion-resistance, great impact toughness. This means a better and more durable product . . . and simpler and less costly fabricating, finishing and handling operations.

Until our metallurgists and engineers know more about your particular products and production methods, we can't tell you exactly how much N-A-X will help you. We're ready to investigate at your request.

MAKE A TON OF SHEET STEEL GO FARTHER
Specify—
N·A·X
HIGH-TENSILE STEEL

GREAT LAKES STEEL CORPORATION
N-A-X ALLOY DIVISION • DETROIT 18, MICHIGAN
UNIT OF NATIONAL STEEL CORPORATION



POWER TAKE-OFF WITH S.S.WHITE FLEXIBLE SHAFTS

Drawing Courtesy of Marquette Mfg. Co., Minneapolis

WITH an S.S.White flexible shaft, rotary power can be taken from the engine and delivered to any point in a car, bus or truck. A typical example is the service car crane illustrated which has a capacity of 3½ tons. From a simple take-off on the transmission, the flexible shaft delivers power to a clutch on the crane drum.

The large selection of S.S.White power drive flexible shafts makes it possible to satisfy a wide range of power needs. And this range can be greatly enlarged through the use of gearing in conjunction with the shafts.

FOR FULL FLEXIBLE SHAFT DATA

see the S.S.White catalog in Sweet's Catalog File for Product Designers or write for BULLETIN 4501.

ENGINEERING COOPERATION

The recommendations of S.S.White engineers on proposed applications are available at all times without obligation.

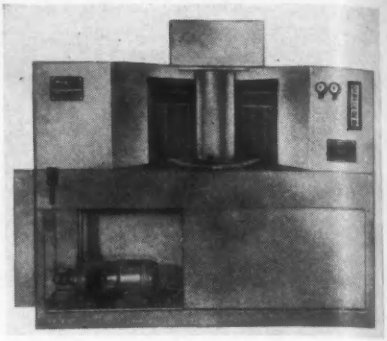
S.S.WHITE INDUSTRIAL DIVISION

THE S. S. WHITE DENTAL MFG. CO.

DEPT. A, 10 EAST 40th ST., NEW YORK 16, N. Y.

FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED RESISTORS • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING

One of America's AAAA Industrial Enterprises

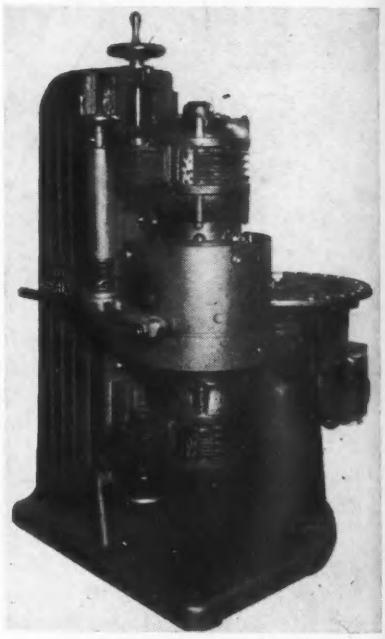


Mabor turn-table washing machine

is completely self-contained and requires little floor space in which to achieve production at an average of 60 baskets per hour. Basket dimensions are 12 in. by 12 in, 16 in. by 16 in., or 20 in. by 20 in., with load capacity of 1800, 2500 or 3000 lb, according to size of machine. The turn-table washer is available in three standard sizes and may also be had with special modifications for unusual problems, where centering of parts is essential. It may be heated by steam, gas, oil or electricity.

CHARLES H. BESLY AND CO., 118-124 N. Clinton St., Chicago 6, Ill., have recently designed a new type double vertical spindle grinder for high output on small parts.

The new direct-drive grinder features a horizontal rotary feed which



Besly double vertical spindle grinder

enables the operator to drop the small parts into the feed wheel rapidly and accurately. For example, the new machine will grind from 3000 to 4000 small coil springs per hour.

Listed as No. 902, this equipment is designed to speed the grinding of steel rollers, brushes, washers, ceramic parts and a wide variety of other small pieces within allowable tolerances.

YOU DON'T HAVE TO

RE-DESIGN

THE VEHICLE TO APPLY VICKERS Hydraulic Power Steering

Vickers Hydraulic Power Steering requires minimum space and can be located where it does not interfere with other apparatus. In nearly all cases it is easily applied to existing vehicle design with only a few simple alterations.

The hydraulic power cylinder is connected to the drag link at one end and the chassis frame at the other; it is controlled by the pitman arm. The existing steering gear is not altered. Hence, Vickers Power Hydraulic Steering is easily applied either as original or as optional equipment.

Steering is finger-tip easy—instantly responsive—and no road shocks can get to the steering wheel. Overload protection and lubrication are both automatic. Fifteen years of successful operation on trucks, buses, and road machines have proved the value of Vickers Power Hydraulic Steering. Write for Bulletin 44-30.

VICKERS *Incorporated*

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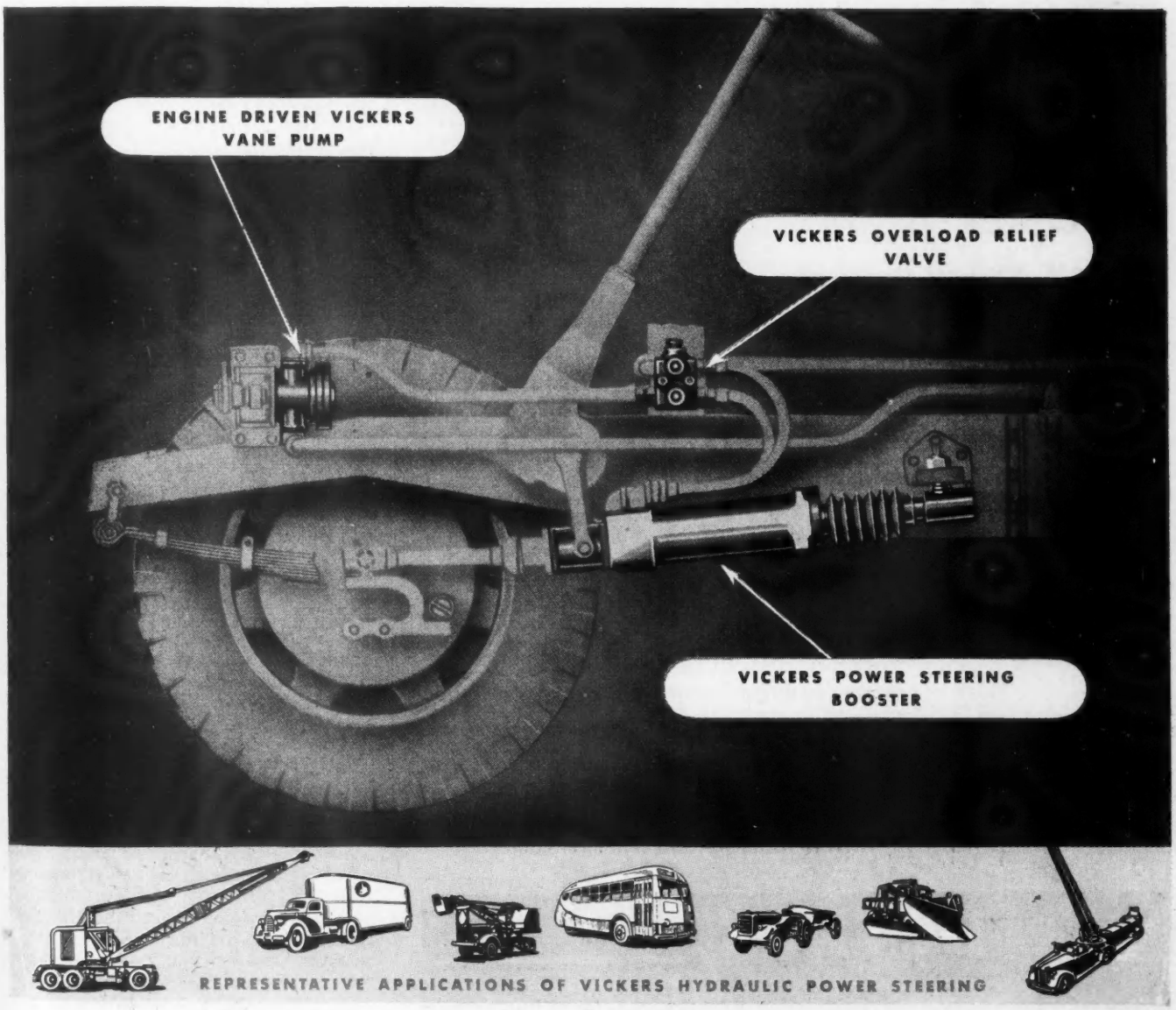
Application Engineering Offices: CHICAGO • CINCINNATI • CLEVELAND DETROIT • LOS ANGELES • NEWARK • PHILADELPHIA • ROCHESTER ROCKFORD • TULSA • WORCESTER



REPRESENTATIVE APPLICATIONS OF VICKERS HYDRAULIC POWER STEERING

Ford Plastics Plant

(*Continued from page* 21)

several points of contact, forcing the plastic over the screen for a permanent fastening after the material cools.

Usual practice is to mold metal inserts such as shafts when the part is molded. At Ford they have found it more economical to make the plastic part first and then press the insert in place. This is a simple light press job, using inserts with knurled ends and heating the plastic part in an infrared cabinet to soften the material so it will yield instead of cracking. Advantage of this procedure is that in the event of spoilage of the plastic part, it is no longer necessary to salvage the metal inserts.

Compression Molding Department

Here the equipment consists of 30 heavy-duty compression molding presses in new and old models built by Watson-Stillman, Lake Erie, and French Oil Mill. Of these there are twenty 500-ton machines and ten 300-ton machines. A study of this operation offers an outstanding example of advanced techniques for molding thermosetting plastic parts of intricate form, including a multiplicity of inserts, and held to extremely fine tolerances on dimensions.

As in other departments of the vast Ford establishment, the management is constantly on the watch for new developments. Among the latest of these is the adaptation of the newer models of Watson-Stillman and Lake Erie presses for high speed plunger molding. To accomplish this, it has been found advantageous to install the necessary overhead cylinder and plunger mechanism. Considered to be the coming technique, plunger molding makes it practicable to mold intricate parts which cannot be handled by compression molding methods. One example of this adaptation is the Watson-Stillman machine set-up for molding the flat distributor cap for the six-cylinder engine, using a six-cavity mold.

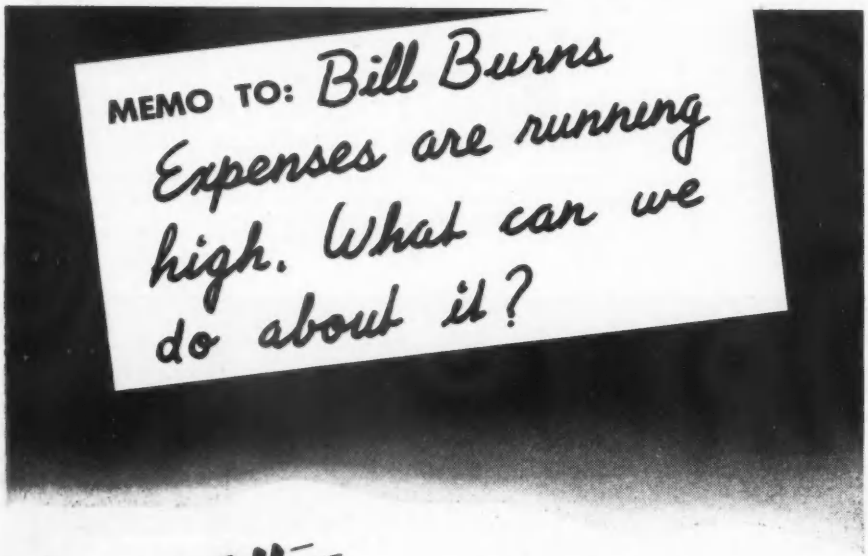
An extensive project is under way to equip molding machines with the high frequency pre-heating units for preparing preforms for the press. Current experience with a Girdler Corp. Thermex unit indicates an improvement in productivity of about 50 per cent through rapid preheating. The successful performance of this unit has been followed by experimental work with high frequency heaters of other makes which should lead to the adoption of preheating units for the entire department.

Preforms of special and standard sizes and shapes used in the compression molding process are prepared in a special department equipped for the purpose. Preforms are made up from the powders, molded and pressed in special machines. All preforms are held in a sealed chamber under standard conditions of temperature and humidity for three to four hours before being delivered to the molding room.

It is emphasized that the design of preforms—as to size, shape and weight—is of vital importance in making moldings of intricate form and complexity of insert arrangement. As an outstanding example of this point, consider the molding of an eight-cylinder distributor cap. It is made in a Watson-Stillman press in a 24-cavity die and requires four preforms—two are cylindrical, one a small doughnut, the fourth, a large disk with clearance slots for the inserts. Bus coil housings, among the larger parts molded here, are produced in the Lake Erie presses, using a 21-cavity mold.

From the molding lines, the parts move into the adjacent finishing department. In addition to hand operations such as burring, grinding and polishing, this department has machine tools for drilling, tapping, turning, boring, etc. A large battery of rubber-lined Baird tumbling barrels is available for tumbling many of the parts to remove burrs.

(*Turn to page* 84, *please*)



SLASH YOUR CLEANING COSTS

It's easy when you install efficient products engineered with an eye for economy. That's why DETREX ALL-PURPOSE TANKS and TRIAD EMULSIONS have earned such a wide acceptance throughout the garage and service station field. Work clearances in AP tanks are large enough for entire motor blocks, yet the design conserves valuable floor space. The AP tanks are available in standard sizes; steam- or gas-heated.

Detrex TRIAD EMULSIONS are recommended for use in AP tanks. Caked-on road dirt, grease and grime are instantly dissolved leaving the parts clean, ready for overhaul and rebuilding. The emulsions provide temporary rust protection for work in process.

Write today for complete information.

DETREX Corporation
DETROIT 32, MICHIGAN
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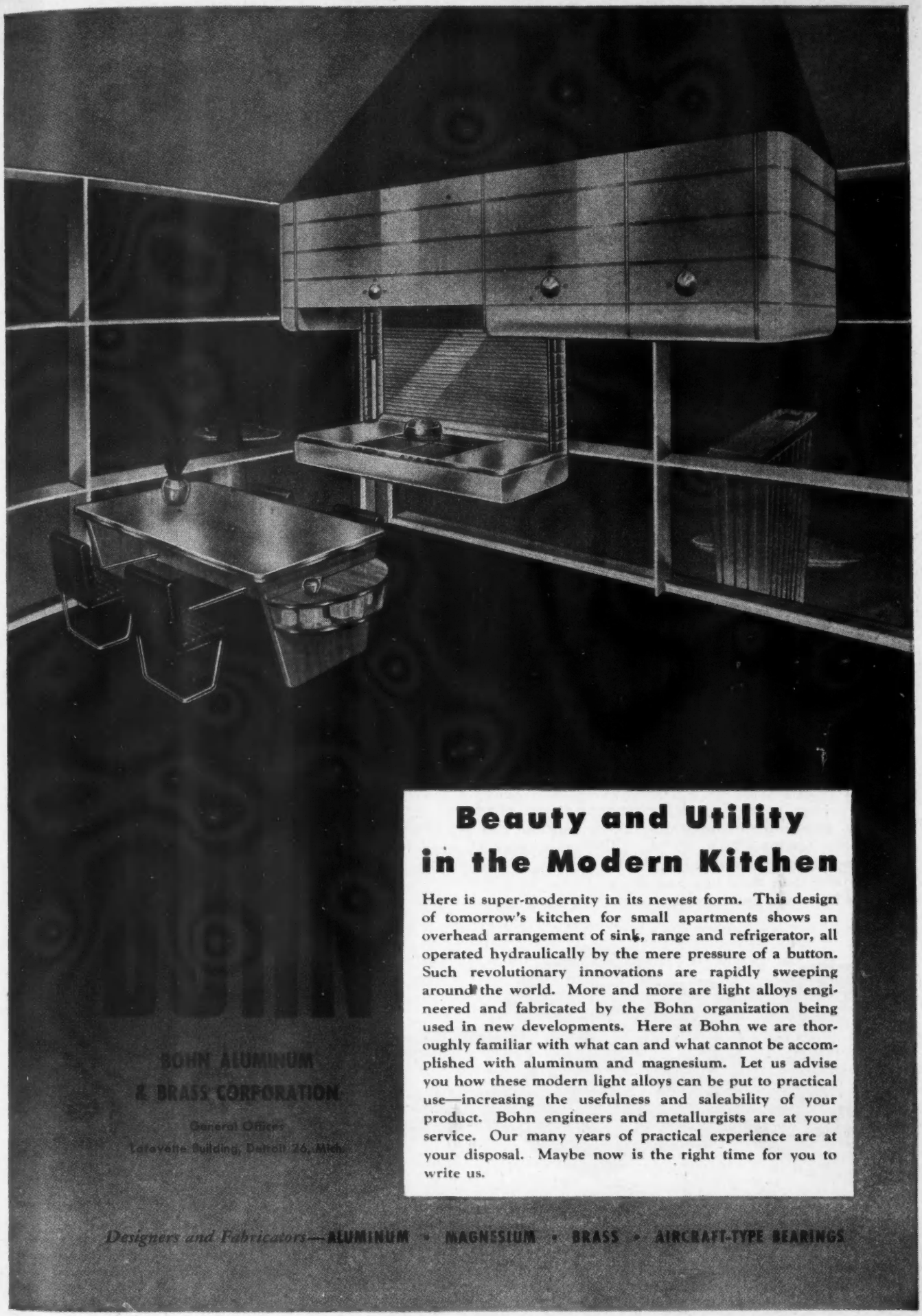


Beauty and Utility in the Modern Kitchen

Here is super-modernity in its newest form. This design of tomorrow's kitchen for small apartments shows an overhead arrangement of sink, range and refrigerator, all operated hydraulically by the mere pressure of a button. Such revolutionary innovations are rapidly sweeping around the world. More and more are light alloys engineered and fabricated by the Bohn organization being used in new developments. Here at Bohn we are thoroughly familiar with what can and what cannot be accomplished with aluminum and magnesium. Let us advise you how these modern light alloys can be put to practical use—increasing the usefulness and saleability of your product. Bohn engineers and metallurgists are at your service. Our many years of practical experience are at your disposal. Maybe now is the right time for you to write us.

Designers and Fabricators—ALUMINUM • MAGNESIUM • BRASS • AIRCRAFT-TYPE BEARINGS

Boosts Monroe Output

(*Continued from page 29*)

Interesting piece of mechanized equipment is the IMF (International Metal Fabricators) automatic spray and baking unit used for coating the top and bottom of eight-cylinder distributor caps with a special arc-resistant coating. Parts are placed in a sheet metal cabinet, serving as a fixture as well as a masking device, and go through the spray booth and drying oven on a monorail conveyor.

A feature of the layout of the compression molding department is the progressive movement of parts from the molding lines, to the finishing department, then finally to a row of inspection benches lining the rear end.

path carrying the painted shock absorbers through a ceiling-mounted infra-red baking station and then to the shipping department.

At this point brief reference can be made to what Monroe calls its "off-the-line" department. Actually this is a separate department for the manufacture of the gamut of small volume shock absorbers for trucks and buses, the large units for railroad equipment, and the small one for motorcycles. Except for making tubing on the Yoder mills, this department is self-contained and deliberately kept apart from the mass production section of the plant.

Sway Bar Production

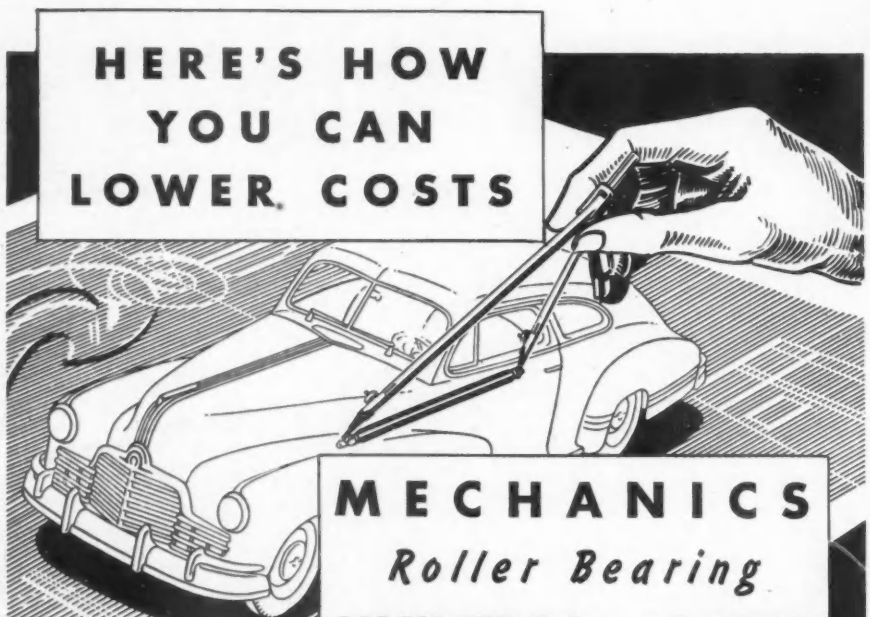
Plant 4, housing the manufacture of sway bars and seats, is an interesting operation in itself, but owing to the limitations of space we shall confine ourselves to a brief summary of sway bar production. Monroe makes sway bars in a variety of sizes and forms for many makes of popular motor cars, thus posing a sizable problem for the manufacturing department. In addition to the variety in forms and sizes, there are differences in materials, requiring different kinds of heat treatment. Some kinds require water quenching, others demand oil quenching, while Amola bars are air hardened. This department, too, has been mechanized insofar as the work permits to reduce manual handling and to speed the flow of work from one operation to another.

Most sway bars require an upsetting operation on both ends to develop eyes or loops. As an example, consider one type of sway bar made from Amola steel. Heating to forging temperature for upsetting is done in a special furnace built by the Selas Corp. This is a narrow, vertical, gas-fired unit, with one side open to receive the end of the bar. The bars are laid on a vertical conveyor, which carries them over the top of the furnace and then move downward through the furnace. This is said to be conducive to fuel economy since much of the heat in the bars is recovered by the furnace atmosphere during the passage of bars from the top to the bottom level. As the bars leave the furnace at the lower end, they are lifted off the conveyor and transferred to the upsetter. This procedure is repeated for the other end of the bar.

From the upsetter, the bar goes to a small Chambersburg board hammer with a three-impression die for forming the large eye. Next it goes through a series of press operations — first a trimming press, then two operations for the formation of the bore to size.

At this point the bar has the formed ends but is still straight. This brings us to the bending operation. In preparation for this, the bars are fed into one of the large gas-fired Surface Combustion furnaces for heating. As the bars complete the heating cycle they are fitted into one of the special hydraulic bending machines developed by Monroe. The cycle of the machine is automatic and extremely fast. Before the bar has cooled, it is taken out of the bending machine and placed on a conveyor in which the first station is an air blast to produce an accelerated air cooling effect desired for Amola steel.

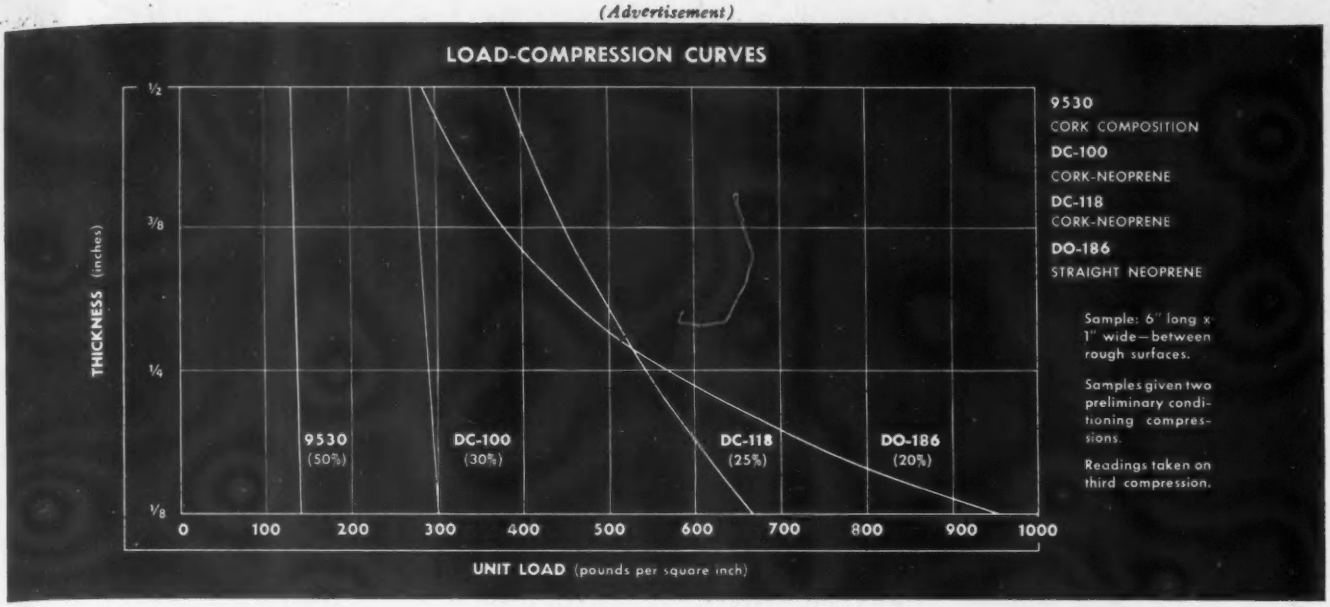
(*Turn to page 86, please*)



The slip-on-the-transmission-shaft feature of this MECHANICS Roller Bearing UNIVERSAL JOINT eliminates the need for the conventional splined stub shaft, thus reducing cost and weight. Let our engineers show you how this and other MECHANICS features will help give your product competitive advantages.

MECHANICS

MECHANICS UNIVERSAL JOINT DIVISION
Borg-Warner
2020 Harrison Avenue, Rockford, Ill. Detroit Office, 7-234 G. M. Bldg.



RELATION OF GASKET THICKNESS TO LOAD

Type of sealing material determines effect of gasket thickness on compressive load

When gasket thickness is decreased, it may be necessary to increase unit load to maintain correct compression, assuming that width is constant. Whether a load increase is necessary and how much may be needed are determined by the type of sealing material used in the gasket.

The curves charted above show the effect on unit loading when the thickness of four different resilient gasket materials is varied. Each material is compressed the average amount recommended for it in normal service.

With a truly compressible material such as Armstrong's #9530 Cork Composition, unit load need not be increased to maintain constant compression. Gasket thickness can be reduced from ½" to ⅛", as shown by the chart, yet virtually the same load produces 50% compression.

A straight rubber gasket, on the other hand, requires a sharply increased unit load when its thickness is decreased. As with all non-compressible materials, its stress-strain curve varies with the ratio of the load area to the free area. The behavior of a typical material of this type is shown above in the curve for our DO-186, a straight Neoprene compound.

By combining cork and rubber in varying amounts, versatile compositions can be made that bridge the gap between cork and rubber. For example, Armstrong's DC-100 is a composition of Neoprene with a high cork content. Its behavior, therefore, approaches that of cork composition. A higher initial load is required to get adequate compression, but this load remains almost constant when gasket thickness is reduced. This is shown in the chart given above.

With DC-118, also charted above, gasket behavior will be more rubber-like because of its relatively low cork content. Here a substantial increase in load is required when gasket thickness is reduced from ½" to ⅛". Other Armstrong's cork-and-rubber compositions provide intermediate degrees of compressibility.

The chart given here illustrates why it is necessary to have ample bolting pressure when the thickness of a rubber or rubber-like gasket is reduced. Where adequate load is not readily available, one of Armstrong's cork-and-rubber compositions may offer a solution.

Since many variables influence the choice of a gasket material, we recommend that you discuss your specific application with an Armstrong representative before you set up your specification. He will be glad to suggest suitable materials and supply test samples.

If you prefer, send drawings and details to us. You will find our recommendations unbiased and keyed to good current gasketing practice.

SEND FOR FREE BOOKLET. For specification and application data on Armstrong's more than 50 resilient sealing materials, send for a free copy of the latest edition of "Gaskets, Packings, and Seals," twelve pages of helpful information. Address Armstrong Cork Company, Gaskets and Packings Department, 1501 Arch Street, Lancaster, Pennsylvania.

ARMSTRONG'S
GASKETS · SEALS · PACKINGS

Cork Compositions • Cork-and-Synthetic-Rubber Compositions
Synthetic Rubber Compounds • Cork-and-Rubber Compositions
Fiber Sheet Packings • Rag Felt Papers • Natural Cork

MOLDING RUBBER is work for Specialists

Continental's specialization is based not only upon its 44 years experience, but upon the development of specialized equipment such as the automatic double ram tilting top press shown below. Millions of molded parts made for scores of industries have earned Continental a high reputation. Whenever you have molded rubber parts to plan and purchase, why not have Continental's recommendation?

See our Catalog in Sweet's

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CONTINENTAL RUBBER WORKS • ERIE, PENNA., U.S.A.

Bars made of other types of steel require special heat treatment. For an oil quenching steel the bars are heated in a Surface Combustion furnace, are bent as described above, then oil quenched, and finally drawn in a Surface Combustion drawing furnace. Unique feature of the oil quenching bath is the installation of a Hapman tubular type chip conveyor for continually removing scale from the bottom of the tank. Since most of the sway bars require the installation of one or more pairs of rubber parts, Monroe has developed a simple type of air-operated assembly machine for pressing the rubber parts in place.

The production of independently suspended seats for tractors and motor trucks marks the establishment of an entirely new activity in the industry. Tractor seats have been made for most of this year on a mass production basis while truck seats have been in production for some time. This operation will form the basis for a special study in this publication some time later.

Aircraft Accessory Equipment

(*Continued from page* 39)

have seriously overstepped the actual capabilities of the catalogued equipment, and to cut out, if necessary, some of the flattery and to insert all the latest technical data available on the equipment. With the manufacturer's engineers thus checking to see that all the data they would require if selecting the equipment is shown, the resulting catalog will save many hours for the aircraft designers.

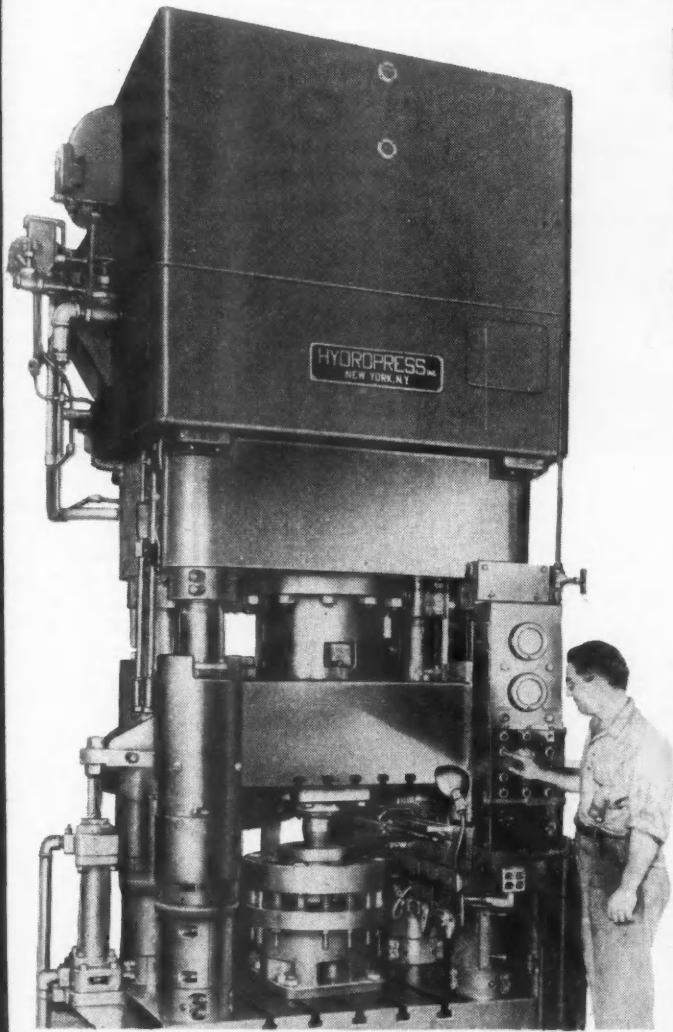
The technical information that should be readily available in a manufacturer's catalog for the aircraft engineer to review during his selection and installation of aircraft equipment is briefly outlined here.

1. Performance Data—This should include all pertinent information concerning the equipment, such as: system pressure or voltage; pressure drop or current drain; efficiency and performance curves; tension, compression or rotary output loads, both operational and ultimate; length of stroke or output rpm; internal wiring or flow diagrams; continuous or intermittent duty; operational time; available ratings and settings; minimum and maximum tolerance of ratings and settings; required heating or cooling.

2. Installation Data—The designing of supporting structure and installation attachments or connections requires that the following esential information be available: manufacturer's correct part and drawing number; complete envelope dimensions; exact size, location and manufacturing tolerance of mounting holes and studs; center of gravity; exact location of hy-

(*Turn to page* 88, *please*)

HYDRAULIC PRESSES FOR POWDER METALLURGY FOR THE AUTOMOTIVE INDUSTRY



500 TON SELF-CONTAINED OIL-HYDRAULIC PRE-PRESSING AND COINING PRESS FOR POWDERED METAL AT THE AMERICAN ELECTRO METAL CORP., YONKERS, N. Y.

MORE THAN SEVENTY AUTOMOTIVE PARTS ARE BEING CURRENTLY MADE FROM METAL POWDERS

GEARS FOR OIL PUMPS
POLE PIECES
OIL PUMP ROTORS
GENERATOR BRUSHES
MOTOR RESISTANCE RINGS
MOTOR ROTOR BARS
BRAKE LININGS
CLUTCH FACINGS
SELF LUBRICATING BEARINGS
SPECIAL HARDENED WASHERS, ETC.

1 AT A FRACTION OF COST
2 AT GREATER SPEED
3 TO CLOSE TOLERANCES
4 WITH LITTLE OR NO MACHINING
5 AT NO SCRAP LOSS

OUR PRESSES ARE CUSTOM-BUILT TO THE SPECIFIC PRODUCTION REQUIREMENTS OF EACH CUSTOMER

HYDROPRESS · INC.

ENGINEERS CONTRACTORS

HYDRAULIC PRESSES · ROLLING MILLS · PUMPS
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draulic, electrical and mechanical connections; type and size of connections to permit mating of parts; free space required for servicing.

3. Operational Conditions — Operation conditions or limitations of a manufacturer's equipment which have been ascertained through laboratory tests and trial flight installations should be available to the engineer. For example: ability of unit to withstand the effects of both aromatic fuel and isopropyl alcohol; effects of engine emergency and idle speeds on equipment; effects of vibration and whether or not the unit should be shock-mounted; recommendation as to preferred position and method of mounting; instructions for servicing the equipment and its recommended service period; expected operational life.

4. Specifications—It should be definitely stated which specification the equipment has successfully passed with the approval of the A-N Board, Army or Navy. If the units have met all requirements of the specification in the manufacturer's own laboratory, but have not been submitted to the services for approval, it should be so stated.

5. Weight—A prime factor in the selection of aircraft equipment is weight and it should be prominently noted on all manufacturers' publications and blueprints. The actual production weight of the unit is preferred; however, the noting of a calculated weight is appreciated rather than not showing any weight.

6. Environmental Resistance — Resulting from the war was the requirement that aircraft and its accessory equipment be capable of operating in any environment. This required accessory equipment to operate satisfactorily at altitudes from sea level to 40,000 or 50,000 ft and at temperatures from —65F to +160F, to be impervious to fungus growth, to be unaffected by salt water or vibration, and a number of other environmental conditions. With commercial airlines now extending their routes to all corners of the globe and with high-altitude flying, all accessory equipment be environment free. It is considered the accessory manufacturer's responsibility to determine by test whether his equipment will successfully pass all the altitude, winterization and other environmental requirements. This information should be readily available for the aircraft engineer when selecting equipment, either in the form of a statement on a catalog sheet or blueprint, or in the form of a certified test report.

7. Noise Suppression—The reduction of mechanical and electrical noise to a minimum is being stressed by both the services and the airlines. This makes it imperative that the aircraft engineer be aware when selecting equipment of what the accessory manufacturer has accomplished in preventing his units from becoming a source of mechanical or electrical noise. Here again, it is considered the manufacturer's responsibility to test and take corrective action to reduce noise emanating from his equipment.

Back in 1897 the type of spark-ignited internal combustion engine we all take for granted today was no more than a gleam in the eye of enthusiasts. There were automobiles, of course, and tractors and portable power units of a sort, but they were clumsy and unreliable by present standards.

That was when the inventor of the first portable storage battery, Thomas Witherbee, set up shop in New York. What he made was called an "igniter" and it was, strangely enough, the lineal ancestor of today's best known *batteryless* ignition unit. In 1904 he formed the Witherbee Igniter Company and when he made a piece of equipment that developed the necessary spark *without a battery* it also was called a Witherbee Igniter. This electric igniter used an entirely different ignition method, and it could produce a strong, hot spark regardless of engine speed.

For years standard equipment on most cars and other internal combustion engines was a WICO magneto — the trade mark was taken from the initials of the original company. The business was moved to Massachusetts in 1909 and when it was reincorporated in 1920 it became the Wico Electric Company, following the trade mark.

Today WICO is the world's largest producer of magnetos exclusively, supplying many of America's largest manufacturers of farm implements, contractors' equipment, outboard motors, and large and small power units of all kinds. A well trained staff of field engineers and more than a thousand authorized service stations throughout America sell to and serve the ultimate users of these economical, reliable magnetos. Wico Electric Company, West Springfield, Massachusetts.

WICO MAGNETOS 50 YEARS OF DEPENDABLE IGNITION

The Spirit of Enterprise

(*Continued from page* 15)

money supply has been the unbalanced federal budget. Government deficit spending to increase consumption at the expense of new capital investment plainly is an outmoded argument now. The tax structure must be revised to stimulate investment in productive enterprise.

Third, there is the matter of government controls over business. As we get rid of regulations imposed in wartime, the time is opportune to look over the entire range of controls with a view to changing or eliminating those which do more harm than good. A lot will be found in this harmful category.

If we are going to make the enterprise system work effectively, this is the time for a general check-up and for action.—*From an address before the Fort Worth Chamber of Commerce.*

Here's an exhaust pipe which really cuts replacement costs

INCONEL* now offers a lasting cure for exhaust troubles... eliminates an important cause of bus and truck "shop-time"

WANT to get rid of annoying exhaust-pipe troubles?

Want to reduce tie-ups of your equipment . . . and at the same time save a surprising amount of unnecessary repair and replacement expense?

Inconel exhaust pipes can do all that for you!

For Inconel has an outstanding record for dependable, trouble-free performance. Withstands 1650° to 1850° F. temperatures and highly corrosive exhaust gases of airplane motors.

When you install an Inconel exhaust pipe, the chances are it will last the life of your truck or bus.

Here are the facts about INCONEL SAVINGS

Checking with truck and bus operators revealed these costly facts:

Tractor-trailer trucks are good for about 80,000 miles per year for 5 years. But standard exhaust pipes generally last less than 25,000 miles. That's 16 pipes in 5 years! It means paying today's high labor charges 16 times . . . that costs real money!

With buses it's even more expensive. Pipes do not last as long and buses average a 1,500,000-mile life. Most companies burn up more than 75 standard exhaust pipes on each of their carriers.

There was one fact on which both bus and truck owners agreed. They cannot afford to keep vehicles in the shop for avoidable repairs. In these days of over crowded schedules and equipment shortages, every hour of service time is priceless.

ONE INCONEL PIPE SHOULD OUTLAST THE ENGINE

Laboratory tests and actual service records have showed that Inconel exhaust assemblies should outlast the engines on which they are installed. How about testing Inconel exhaust pipes, muffler interiors and manifolds on your equipment? The International Nickel Company is ready to cooperate with you in working out proper designs and types for your vehicles.

FURTHER PROOF of Inconel's durability in exhaust service comes from a large transportation company. Inconel muffler interiors were installed on several of their carriers a few months ago for test purposes.

Recent inspection, after 100,000 miles, revealed no damage to the Inconel interiors. This mileage, the company reports, is already about 4 times greater than they had previously obtained from standard muffler interiors. The Inconel assemblies were put back in service and they're still going strong.

Fill out and mail the coupon below and we will tell you how an inexpensive test can be made on your own buses and trucks.

The International Nickel Company, Inc.
67 Wall St., New York 5, N. Y.

I am interested in testing Inconel for exhaust parts on my vehicles. Please send me full information.

Name.....

Position.....

Company.....

Address.....

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THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N.Y.

NICKEL (INCO TRADE MARK) **ALLOYS** MONEL* • "K"* MONEL • "S"* MONEL • "R"* MONEL • "KR"* MONEL • INCONEL* • NICKEL • "L"* NICKEL • "Z"* NICKEL

*Reg. U. S. Pat. Off.

Looking Ahead Into 1947

(*Continued from page* 17)

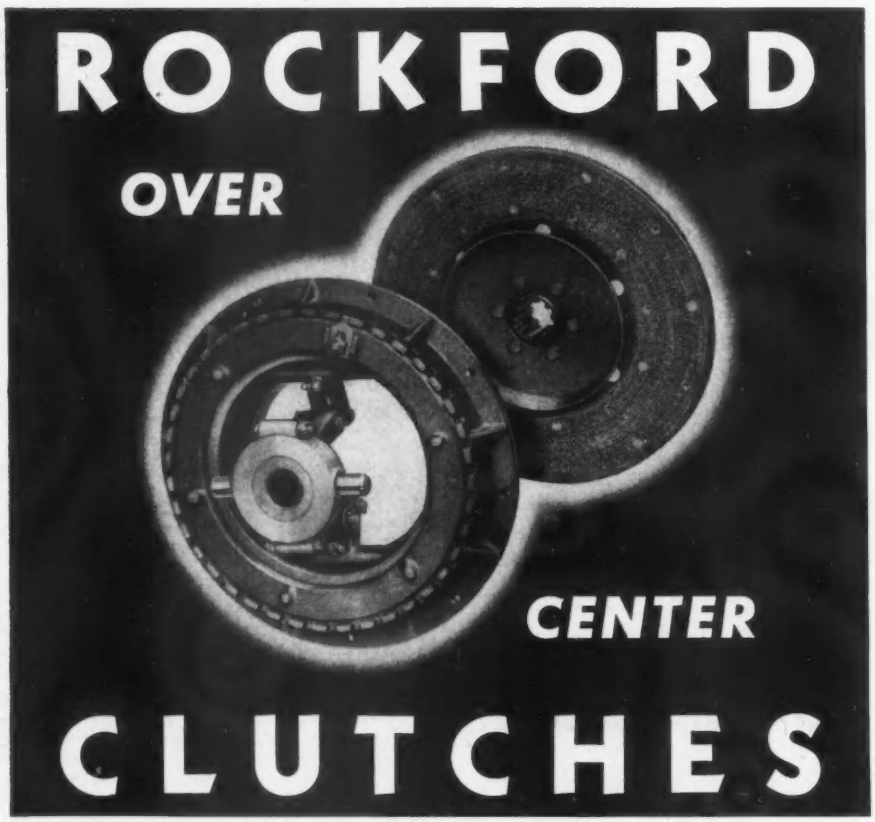
In the field of materials, shortage of sheet and strip steel continues as the most important impediment to all-out automotive production. The effect of the recent coal strike is expected to be felt during the first quarter of the year, since it is estimated that enough steel to build about 250,000 vehicles was lost due to curtailed steel making operations. However, the principal bottleneck still lies in the lack of processing facilities to roll the forms of steel required by the automotive industry, mainly sheet and strip. This is expected to put a ceiling on production of cars and trucks during the first quarter, at least, at about or slightly above the rate prevailing at the end of 1946. By the end of the first half of 1947, new sheet and strip rolling facilities, now under construction, should be coming into operation and allow full volume output of automotive vehicles sometime in the last six months.

Another cause of concern to automotive manufacturers is the present high prices of cars and trucks. Passenger car prices now stand at from 45 to 50 per cent over the 1941 level, and although there is no indication yet of any serious buyer resistance, manufacturers are well aware of the potential threat to sales. Labor productivity figures prominently in production cost, and there have been some indications recently that the situation has improved slightly. It still stands below the 1941 level, but with an improvement in the flow of supplies, should continue to climb back toward prewar levels. If the industry could wring some kind of concession from labor to improve productivity in exchange for a wage increase, the net effect would be healthy. However, the UAW-CIO has announced publicly that it is opposed to any increase in productivity through any additional expenditure of physical effort on the part of the workers, so the chances for any voluntary agreement to step up output through more work effort per man are exceedingly remote.

The portal-to-portal pay suits which have been snowballing into claims almost rivaling in some cases the total capitalization of smaller companies pose some very interesting problems, not only for automotive manufacturers, but for all industry. While there is no attempt to minimize the seriousness of the situation, there is nevertheless a growing feeling that the outlook is not quite so ominous as first supposed during the initial period of alarm following the filing of the first suit. The very magnitude of the claims involved and the adverse effect on industry and business in general if they are allowed are in themselves hopeful indicators. Because of the profound effect on the economy of the country, it is felt by many that some redress will be found to take industry from under a crushing burden for the creation of which it is in no way responsible. It is impossible, of course, to discuss all of the legal implications involved, but in general there are several avenues of relief that now are being considered.

First of all, there has as yet been no interpretation by the lower courts of the Supreme Court ruling. In brief, this held that certain time spent by the employe on company property in travel to the place of work, preparing for work, getting machines and tools ready, and similar activities is compensable by reason of being performed in the interest of the employer. Determination of the amount of such time involved was returned to the lower court, and the outcome there will have much to do with future suits.

Another possible development is that a test case may be carried again to the Supreme Court and that a reversal of position there may result. The high tribunal has been known to reverse itself, and with the serious threat to the economy of the nation a vital factor, the Court might reverse or modify its position on collectibility of back pay and damages for portal-to-portal pay.



EASY OPERATION
HIGH TORQUE *
POSITIVE ENGAGEMENT
LARGE DRIVING AREA
SMOOTH RUNNING
INFREQUENT ADJUSTMENT
MINIMUM INERTIA

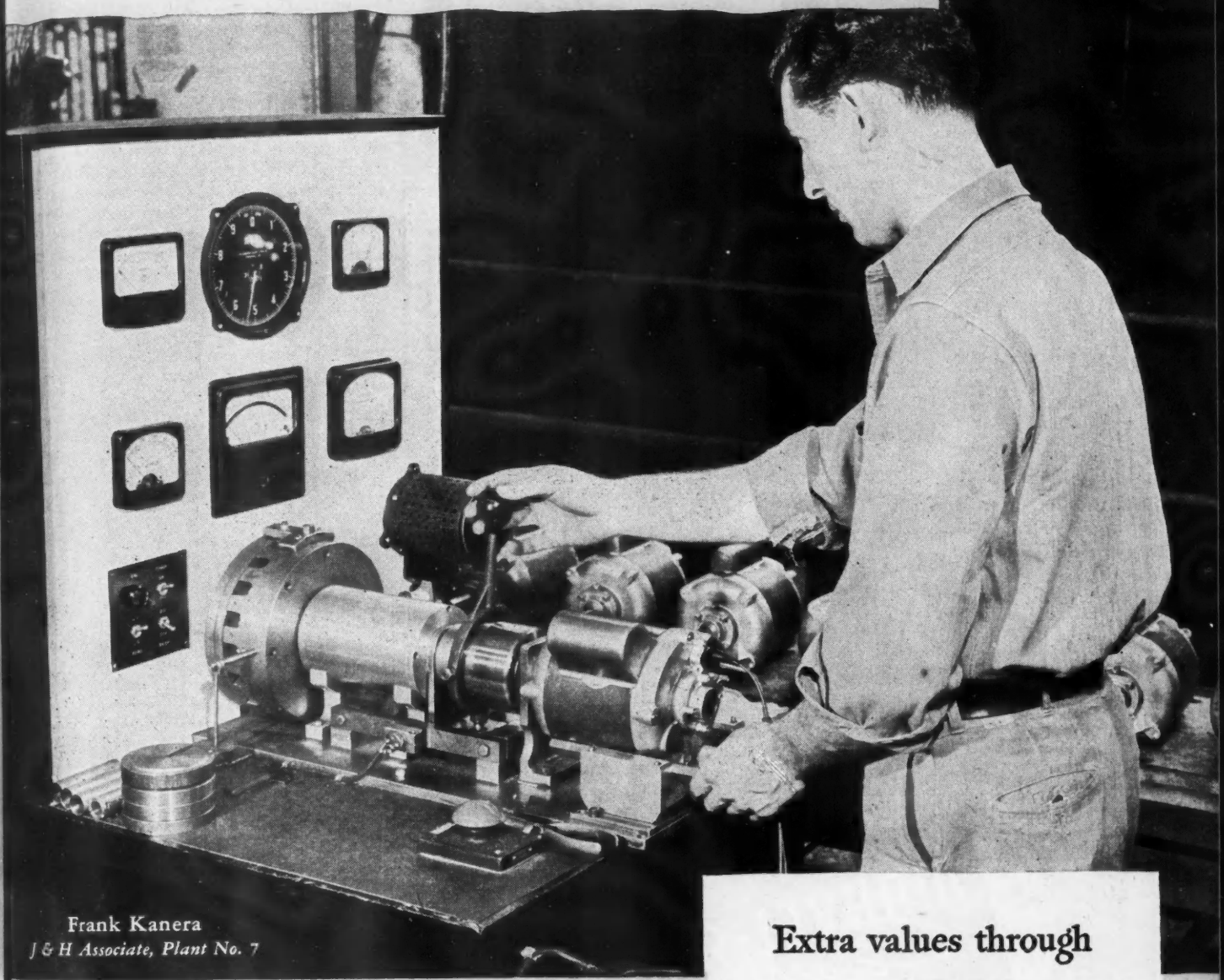
* Equally spaced, hardened and ground roller cams, bearing upon hard steel insets, exert heavy pressure evenly over the entire ROCKFORD Over-Center CLUTCH face — producing unusually high torque, for the clutch size and weight.

Send for This Handy Bulletin

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD CLUTCH DIVISION BORG-WARNER
315 Catherine Street, Rockford, Illinois, U.S.A.

Measuring muscle by electronics



Frank Kanera
J & H Associate, Plant No. 7

Extra values through

JACK & HEINTZ

Mass Precision

The usual way to measure the torque of electric motors is to use an apparatus of wheels, brakes and weighing scales. This method was too slow and cumbersome for the new Jack & Heintz Fractional Horsepower Motor Plant. So Jack & Heintz Production Engineers developed an ingenious electronic dynamometer which measures motor torques *in a few seconds* with unheard-of precision. An operator simply plugs in the motor and reads the torque on a dial. This helps speed up the production of Jack & Heintz motors for urgently needed appliances.

This is typical of the achievements of Jack & Heintz *mass precision* which are producing extra values in motors, refrigeration compressors, aircraft accessories, Eisemann magnetos and bearings *today*, and which promise startling developments for *tomorrow*.

JACK & HEINTZ PRECISION INDUSTRIES, INC., *Cleveland 1, Ohio*

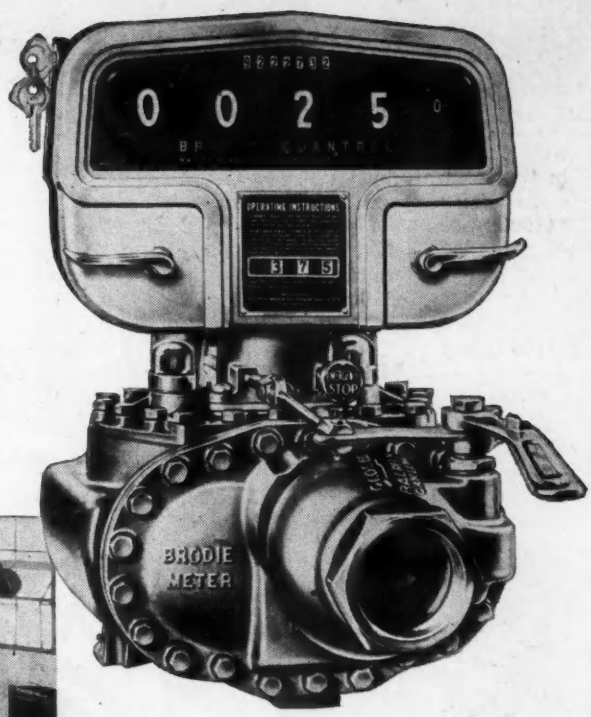
A point sure to be made by the automotive industry is that portal-to-portal pay never was an issue in union contracts and that there was a meeting of minds between union and management on what constituted the 40-hour work week, so that no bad faith was involved.

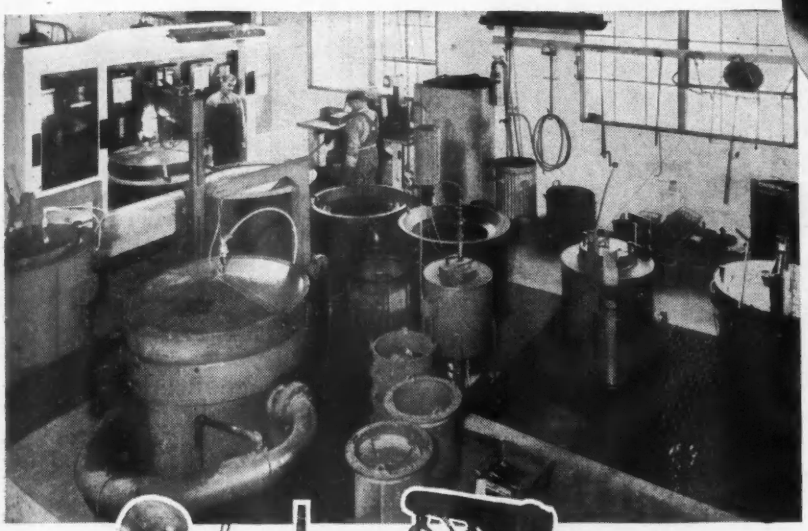
A third possibility, and one that is currently receiving most consideration, is that Congress will come to the rescue of industry with any one of several measures. It could define the work week as being that prevailing as a matter of custom at the time the Wages and Hours Law went into effect in 1938 or as defined in union contracts at that time. It could effect a statute of limitations of one year on all such back pay suits to supersede those of the several states running back many years. It also could enact a "windfall" tax law to drain off 100 per cent of such claims collected, similar to the one passed when the agricultural adjustment act was declared unconstitutional to recover processing taxes that had been collected previously. Since the government itself has a large stake in the present back pay claims, it is felt that Congress will do something to ban or greatly limit their scope. The loss to the national treasury through tax refunds to companies forced to pay back pay claims would run into billions.

Regardless of the outcome of present suits, however, one thing is certain. Portal-to-portal pay has suddenly been injected into the automotive industry and unless Congress specifically defines the work week as that which has prevailed heretofore, it is going to mean added labor costs to management. Unions, which have long sought every means to get more pay for less work, have seized upon the present situation to further that end. There is considerable belief, too, that the rash of pay suits is being brought as much to force other concessions dear to the heart of union leaders, such as guaranteed annual wages and health and accident funds, as to win large awards for individual members. Union leaders are well aware of the pitfalls that lie ahead in the courts and in Congress and are, therefore, apparently trying to panic industry into making concessions on other desired objectives.

In general, much more optimism pervades the automotive industry at the outset of the year than was evident a year ago. Most of the reconversion work is out of the way; the labor outlook, while not bright, is much better than it was at this time last year; during 1946, it was a great number of parts and materials in short supply that was holding up production, whereas now it is only steel and perhaps a few other materials, and production lines are operating much more smoothly with employes who have a full year of experience behind them. Forecasts of production this year envision an output of about 4 million cars and more than a million trucks, with most of this number built in the second half.

LOW-REJECT Heat-Treatment for HIGH-QUALITY PARTS





Brodie Quantrol positive-displacement meter for petroleum products. Its parts are heat-treated by Homo Methods to assure accurate operation. The big-capacity, modern Brodie Heat-Treat Dept. is shown at left.

Accurately-finished parts, made of Nitriding alloy, being lowered into Homo Nitriding Furnace for thorough, accurate heat-treatment.

In making meters for gasoline, etc., the Ralph N. Brodie Co. of Oakland, California, faces two heat-treating problems familiar to hundreds of manufacturers—they must have high quality and they want few rejects. Brodie solved the problems as hundreds of others have done—by the Homo Methods.

All Homo Method equipments, whether for Tempering, Carburizing, Gas-cyaniding or Nitriding have "foundation-stone" features which the Homo Method pioneered. All heat the parts with great uniformity, and are especially good for big or dense loads. All have fully-automatic control; all have large capacity per foot of floor space.

Around these foundation qualities we design the various specialized Homo equipments. Atmospheres, materials, sizes, etc., are handled with accuracy and precision. High quality heat treatment, with low cost, is the result of this thoughtful, thorough design and construction.

We'd like you to put up to our engineers any parts heat-treating problem you may have, so they can show you in detail just what L&N methods can do.

LEEDS & NORTHRUP COMPANY, 4966 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad T-620(24)

Pneumatic Fatigue Testing

(*Continued from page* 31)

with the alloy), necessitating a change in the total air path. The change necessary for a typical sample might be:
*1100 ft/sec
——————— = 4.4 ft or 2.2 ft for one-half wave length at 250 c.
250 cps

1100 ft/sec
——————— = 5.24 ft or 2.62 ft for one-half wave length at 210 c.
210 cps

Total increase in air path is 0.42 ft or 5 in.

An electric furnace is utilized to allow bucket tests at a temperature of 1700 F. By altering the design of the support almost any standard test piece may be run in the machine.

Current work in this field is giving preliminary data which indicate, by using a recording frequency meter and a chart, what appears to be a point of incipient failure. The chart is also a permanent record of the frequency and the time of run. The curve is flat at a constant frequency for the greater part of the test, but for some time before a visible crack appears the chart reveals a gradual decrease in frequency. The point at which this frequency deviates from a horizontal line is considered to be an indication of the point of incipient failure. As may be expected X-ray and Zyglo tests fail to detect any crack if the piece is examined at this time. However, an increase in the number of stress reversals will cause the crack to appear and later become visible. In some pieces an internal flaw may be the origin of this incipient failure and the crack will take longer to appear at the surface. The most recent information indicates that in brittle materials the point of incipient failure occurs at comparatively few cycles prior to total fracture, but that in ductile materials the spread between the point of incipient failure and that of total fracture may amount to as much as 30 per cent of the total number of stress reversals necessary to produce complete fracture. The slope of this decreasing frequency curve may be taken as an indication of the rate of growth of a crack through a particular alloy at a given stress. Samples made from various alloys show an appreciable difference in rate of crack growth.

This pneumatic fatigue machine has been found to lend itself well to the determination of Young's Modulus at elevated temperatures. All that is required for this determination is the correct value for Young's Modulus at room temperature and the frequency of the test piece at any elevated temperature:

$$E_{hot} = E_{cold} \times \left(\frac{fh}{fc}\right)^2$$

In some cases, it is possible to use this machine for a non-destructive test on parts which may contain minute flaws, inclusions, or forging folds. It is first necessary to run an endurance curve on the part in question. From this curve and the test information it is possible to obtain a value for the resonant frequency of a perfect part. From then on it is simply a matter of checking the resonant frequency of a part or test piece. If a part is found to have a lower resonant frequency it is usually due to some imperfection. On the other hand, if the frequency is well above the established frequency, it is reasonably safe to say that the test piece is over-sized at the point of maximum stress.

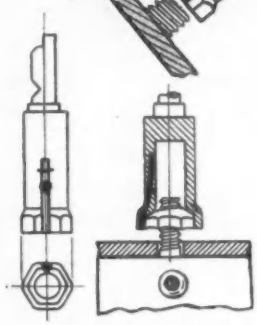
A torsional fatigue testing machine for both room and elevated tempera-

* Measurements of the total air path show that it exceeds the length required for a true half wave length by a small amount. A thorough investigation of the pressure distribution throughout the tube length indicates that this added length acts as an impedance matching device. For maximum transfer of energy, the impedance of the resonant air column should match the impedance of the vibrating cantilever.

Speed Up Assembly!

PALNUTS

APPLY EASILY WITH POWER DRIVERS



This Palnut Socket for power drivers has a spring finger which holds Palnuts securely in socket while starting them on thread and tightening to locked position.

● Self-locking PALNUTS are great time-savers on fast assembly lines. By using a Palnut socket attachment in your power drivers, Palnuts can be run on speedily in any position, whether driver is vertical or horizontal. Drive either the screw or the Palnut.

Palnuts lock as they tighten, eliminating need for regular nut and lockwasher. One part is handled, instead of two, further reducing assembly time, as well as cutting costs.

Self Locking Palnuts are inexpensive, single thread, spring tempered steel locknuts, which exert a powerful double locking action that resists vibration. Many types for various applications, in a wide range of standard sizes.

Send details of assembly for samples. Write for literature giving full data.

THE PALNUT CO., 60 Cordier St., Irvington 11, N. J.

Detroit Office: 3-213 General Motors Bldg.

Self-Locking PALNUTS

★ EXCELLENT ★

AGE RESISTANCE

RESILIENT parts made from HYCAR American rubber resist the aging effects of air, sunlight, ozone, heat, cold, and all other types of oxidation. That's why they *stay* resilient—and stay on the job for a long, long time.

Other important properties of HYCAR American rubber are shown in the box at the right. And it's important to know that these properties may be had in an almost limitless number of combinations—each compounded to meet a given set of service conditions.

We make no finished products of HYCAR. But we urge you to ask your supplier for parts made from this versatile material. You'll learn for yourself that it's wise to use HYCAR—in difficult or routine applications—for long-time, dependable performance. For more information, please write Dept. HD-1, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

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1. *EXTREME OIL RESISTANCE — insuring dimensional stability of parts.*
2. *HIGH TEMPERATURE RESISTANCE—up to 250° F. dry heat; up to 300° F. hot oil.*
3. *ABRASION RESISTANCE—50% greater than natural rubber.*
4. *MINIMUM COLD FLOW — even at elevated temperatures.*
5. *LOW TEMPERATURE FLEXIBILITY — down to —65° F.*
6. *LIGHT WEIGHT—15% to 25% lighter than many other synthetic rubbers.*
7. *AGE RESISTANCE—exceptionally resistant to checking or cracking from oxidation.*
8. *HARDNESS RANGE—compounds can be varied from extremely soft to bone hard.*
9. *NON-ADHERENT TO METAL—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)*

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tures is shown schematically in Fig. 3. The test piece (A) is a vertical shaft with a small flywheel (B) at the upper or free end. On this flywheel are two pistons (C) diametrically opposite and with their axes on an arc having the same center as the wheel. The cylinders (D) are also formed on this same arc so that the pistons may enter them without touching the walls. In this case, the operation is the same as the cantilever machine except that the air impulses are in phase rather than 180 deg out of phase. When two pistons are used it is important to keep them in phase otherwise a bending moment is superimposed on the torsion. It is, however, possible to use two sets of opposed pistons diametrically opposite each other and then have the cylinders adjusted to one-half a wave length.

A miniature fatigue machine of opposed cylinder type has been built, but, as it is used for vibrating strip 0.002 in. thick, it cannot have pistons because they would reduce the natural frequency to too low a value. Therefore, it has been designed to have the strip act as its own piston. This machine has operating frequencies of from 300 to 1200 c, thus making the time of testing very short. Ten million stress reversals may be obtained in less than 8 hr. The test piece for this unit is a 0.25-in. wide strip 0.002 to 0.030 in. thick; the length may vary from 0.5 in. to 1.25 in. depending upon the frequency desired. The frequency and time of test are recorded on a photo-electric recorder using a photo-tube pickup device, and the amplitude is read optically.

Thrust Augmentation

The problem of slow takeoff peculiar to the turbojet aircraft has received attention in two forms of thrust augmentation in recent months. One method consists of water or alcohol (or a mixture of both) injected into the compressor of the engine to cool the air during the compression stage, thereby improving combustion. This method has been used in the General Electric TG-180 axial-flow turbojet engine used in the Republic XP-84 Thunderjet in setting a new American speed record of 611 mph. The other method is afterburning, in which fuel is injected into the exhaust tail pipe of the engine. Following passage of the hot gases through the turbine, this additional fuel and combustion provides additional energy directly to the jet. Thrust increases of as high as 50 per cent have been achieved by this method. Principal drawback of both methods, however, is the extremely high fuel consumption resulting from this flow of liquids into the engine.